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ELECTRICAL WORLD

January 13
1934

25 cents per copy

McGraw-Hill
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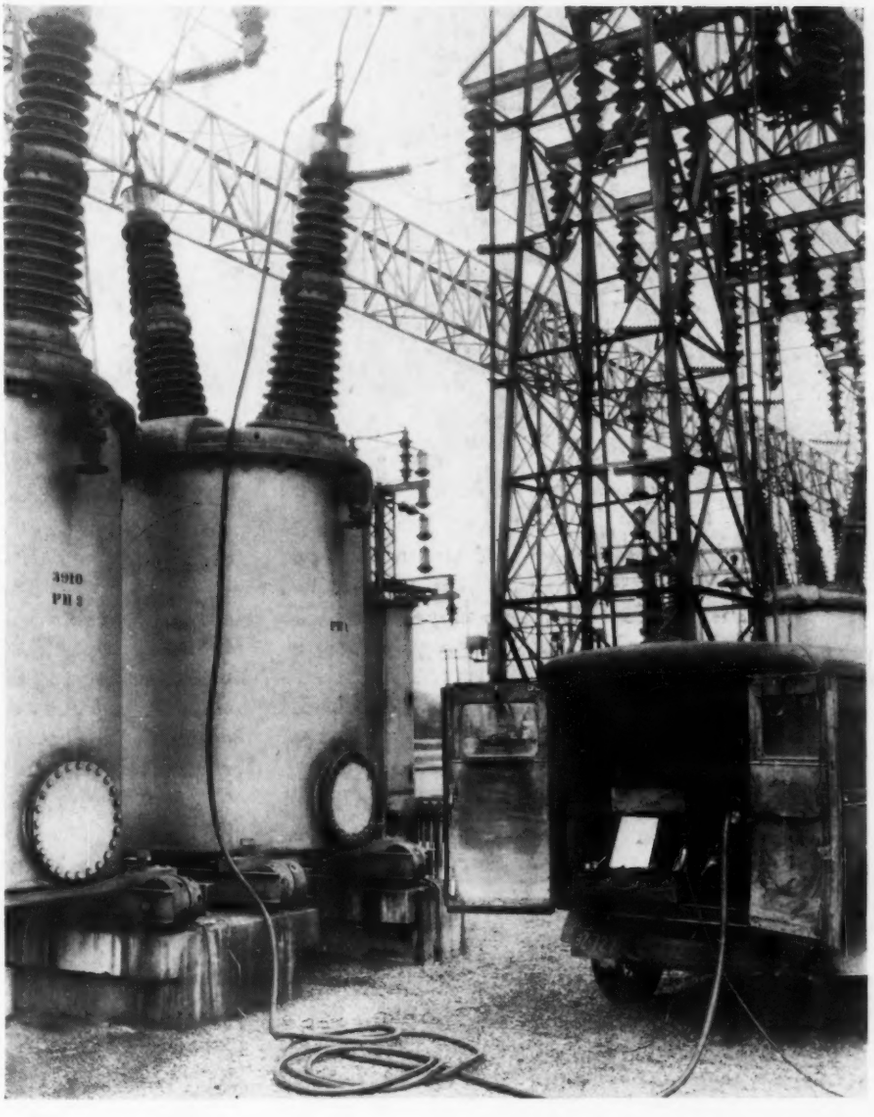
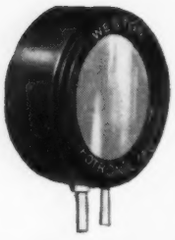
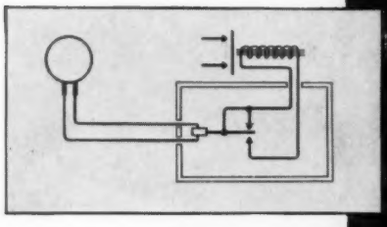


MAINTENANCE RECEIVES ATTENTION

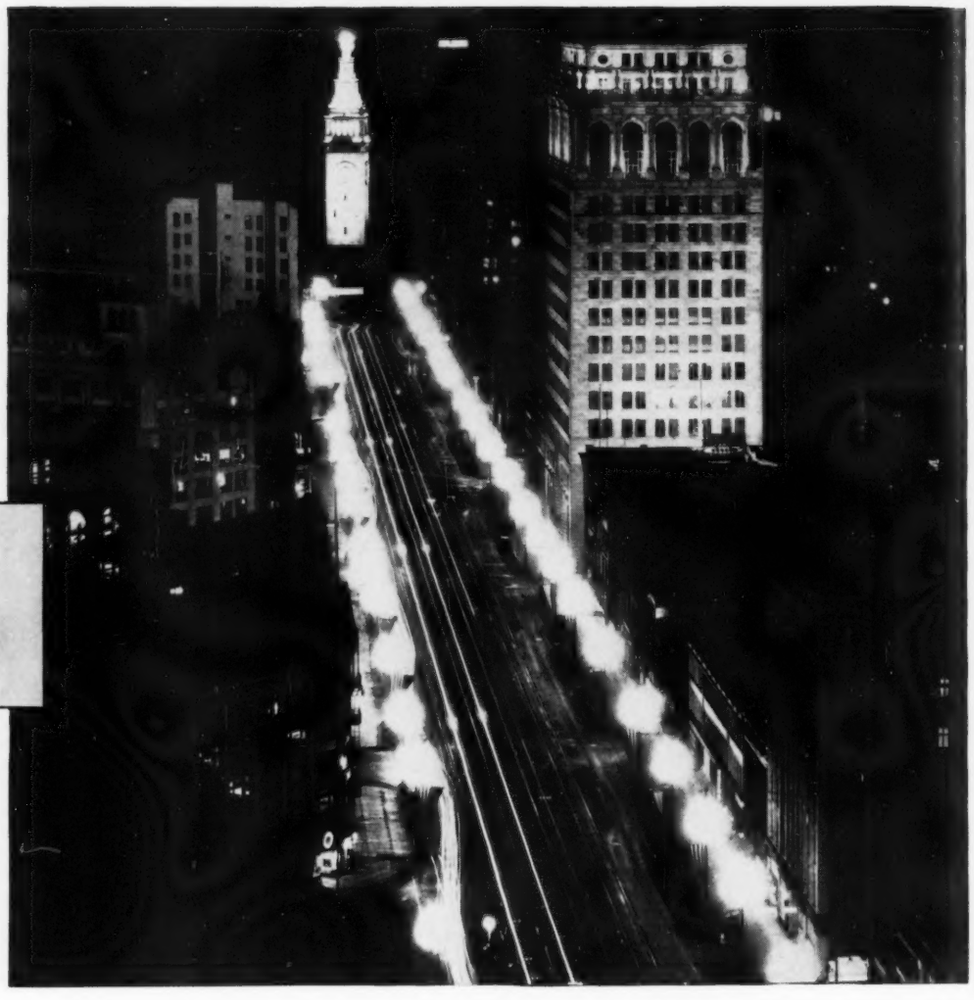
Power-factor test equipment ready to test conditions of bushings on 132-kv. breakers of the American Gas & Electric system . . . Maintenance of electrical equipment is now receiving attention because of a too-frequent neglect during the depression years.



A TINY CELL



A *Simple* CIRCUIT



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Automatic control of street and road lighting by the photo-electric method is now fool-proof—*now practical.* The simplified Weston Lighting Control, using the Weston *PHOTRONIC light-sensitive Cell, has removed all drawbacks heretofore present in this method of control.

The Weston PHOTRONIC Cell employed is of the self-generating type, dependent on no external source of energy for its operation. There is no amplification required between the cell and control relays. The cell can be placed at any point where it obtains an unobstructed view of the north sky . . . the control relays located near the switching operations, a mile away from the cell if necessary. Adjustments for light intensity control values may be made by merely setting a pointer on a marked dial. No field adjustment necessary . . . no photometric set-up required. In the event of damage, replacement units are turned over to the lineman for installation completely adjusted. And the total energy consumed by the device is but a few watts.

The reliability and economy of Weston PHOTRONIC Lighting Control has been proved by many installations in utility service and on American airways. The facts are available and will gladly be furnished to those interested . . . Weston Electrical Instrument Corp., 578 Frelinghuysen Ave., Newark, N. J.

*PHOTRONIC — *a registered trade-mark designating the photoelectric cells and photoelectric devices manufactured exclusively by the Weston Electrical Instrument Corporation.*

WESTON *Instruments*

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

What in the World!

Each year we give birth to a special statistical and progress number. This is the climax of hard work, planned production and an infinite amount of detail effort. So we looked upon last week's new addition with parental fondness and launched it into the world of readers with best wishes for its success. From comment received this was a happy, handsome infant that pleased readers. The strong and courageous policy statements of Cortelyou, Davidson, Egan, Tritle and Whitehead struck responsive chords. The statistics were complete and quite encouraging, in the opinion of readers. We are happy about this reception and want to thank the many industry men who made it possible.

●

For the coming year we plan a larger and better "Electrical World." More pages, more staff, more punch, better articles, stronger editorials, new typography. This policy is based upon our firm conviction that business will be better—that advertising and circulation will increase to support the program. We know the increased service is needed and we are going to give it to show our faith and confidence in the future of the electrical industry.

●

Current plans call for a complete report of the A.I.E.E. convention. This is going to be a good meeting and we hope all engineers will take advantage of the opportunity to attend. More engineering discussions, more personal exchanges of engineering opinions and experiences, a greater development of the Institute services—these are the roads to progress. The midwinter A.I.E.E. is an appropriate time for all electrical engineers to get together.

●

Between forced rate reductions, governmental construction of more generating plants, present excess capacity on private utility systems and new ideas such as the Farm and Home Authority the coming year is going to force the electrical industry to sell its products and services. Selling becomes a necessity at last.

L. W. W. MORROW, Editor

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JAMES H. RUDD
Publishing Director

JANUARY 13, 1934

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Electrical World articles are indexed in Industrial Arts and Engineering Indexes, available in public libraries

ELECTRICAL WORLD—Published weekly, price 25 cents a copy. Subscription rates—United States, Mexico and Central and South American countries $5 a year. Canada, including duty, $7.50 a year. All other countries $9, or 36 shillings, a year. Entered as second-class matter January 20, 1907, at Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S.C.

Printed by The Schweinler Press, N. Y.

McGRAW-HILL PUBLISHING COMPANY, INC.

330 West 42d Street, New York, N. Y.

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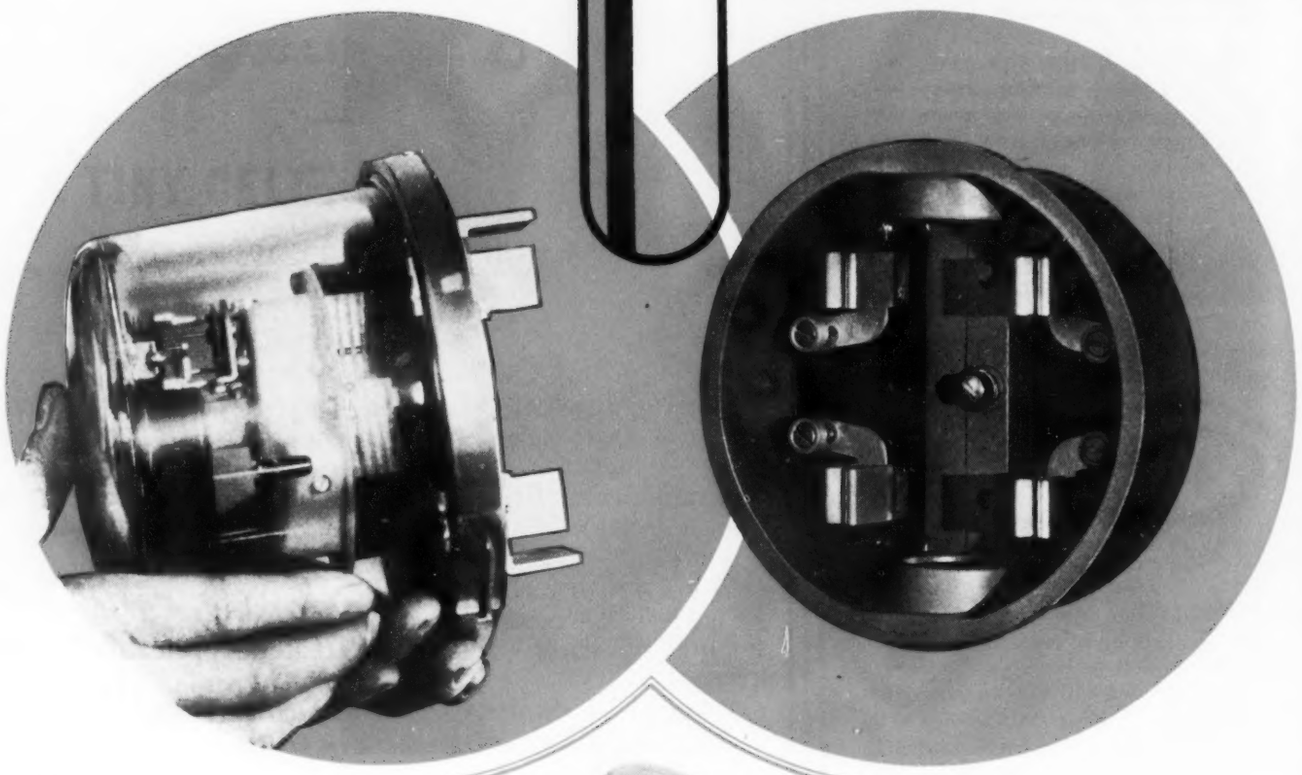
NRA MEMBER U.S. WE DO OUR PART

NIVERSALLY



The universal detachable meter is interchangeable in any type of service or rating. This is the new type CS available in 5, 15 and 50-amp. capacities. Accurate up to 300% of rating, it measures all loads up to 150 amps.

Type S meter-socket. The CS meter and all meters armor-mounted with type S parts are universally interchangeable in this socket. Although rated at 50 amps., its contacts are ample for a continuous load of 150 amps.

New meters of the detachable type, all universally interchangeable in the type S socket, are now manufactured by the following companies:

Duncan Electric Company
Lafayette, Indiana

Sangamo Electric Company
Springfield, Illinois

Westinghouse Elec. & Mfg. Company
Newark, New Jersey

These are the type S parts required to remount old meters for universal detachable service—only four items. From bottom to top: The socket, sealing ring, base plate and cover.

All makes of meters, Duncan, General Electric, and Sangamo, as well as Westinghouse, can be converted into universal detachable meters with the type S armor-mounting parts, shown at the left, at very low cost. Remounting can be done in your own meter departments, or at the following factories:

Duncan Electric Company
Lafayette, Indiana

Sangamo Electric Company
Springfield, Illinois

Westinghouse Elec. & Mfg. Company
Newark, New Jersey

ELECTRICAL WORLD

Established 1883—McGraw-Hill Publishing Company, Inc.

for the Week Ending

January 13, 1934

L. W. W. MORROW, *Editor*

Strategy or Capitulation?

A DEFIANT and resolute light and power industry met recently in St. Louis to agree upon its NRA code. Utility leaders issued a stirring call to arms and seized upon the necessity for adopting a code to call for a showdown on unfair governmental and municipal competition and other discriminations against privately owned utilities. They stated, in effect, that the basic principles of NRA must be put into operation by the government in its own utility program before they would accept a code. They stated that principles of fair practice must be applied to all utilities, governmental, municipal and private. These leaders brought up the issue and aroused the martial enthusiasm of the industry. They sought and found support for their policies and for these provisions in the preliminary draft of the utility code. This is a matter of record. Apparently there was a revivification of aggressive leadership that augured well for the future.

And so to Washington. What happened there has not been told and the industry must judge results only. These are embodied in the released draft of the utility code that will be discussed in a public hearing. Based upon this document, one seeks vainly for that valiant and intrepid spirit and for those "showdown" provisions so ardently promised and urged in the St. Louis polemics. Power has given way to weakness, a courageous statement of principles to an evasive elaboration of non-essentials. Based upon the evidence, obeisance has been made to expediency and conviction has given way to temporizing. This code represents neither the spirit nor the policies stated at St. Louis. It is the final emasculated result of a dynamic issue that was created voluntarily and energetically. This is the battle flag that was to have been flaunted in a life and death battle with the government on the field of public opinion. A masterpiece of compromise supplants a Magna Charta.

Our own opinion has been stated previously, that it was not advisable to create this issue. It never pays to fight the government and, under present conditions, a simple labor code could have satisfied appearances, while the real work of the industry could have been devoted to the development of a more favorable public opinion to which the government would respond. But the majority of the industry agreed upon creating the issue to force a showdown. It welcomed the new and militant leadership. It welcomed a cause and a fighting spirit almost in a mood of desperation. All agreed that the time had come to bring the utility situation to a climax.

Many in the industry cannot and will not understand, therefore, the present about face, this retreat from a chosen position. Rumors fly about laughter in high places when the case was presented. There may have been valid reasons for changes given to those in charge of Washington negotiations, but surely this laughter could have been anticipated and these reasons obtained before the issue was created in St. Louis. Did industry leaders expect Washington to welcome their pro-

posals and to accept defeat without a battle? A life and death battle could have been foreseen.

We do not believe that war ever accomplished anything worth while, but when a battle is started premeditatedly we like to see it waged courageously, even unto death. There is glory in defeat that never is admitted, there is ignominy in an offensive that ends in retreat. We can find no reason to compliment utility leadership in this battle of the code, and we hope a full explanation of the reasons for the attack and the retreat may yet be made to the men and women of the industry.

T.V.A. merchandising

If the present plan is carried out the Tennessee Valley will make an important contribution to industry load-building experience. It will be a laboratory experiment in popularizing electric service on a scale never before attempted. And since the power companies in the area and the manufacturers of appliances are all tied into the program, much should come of it.

This co-operation will combine a number of promising elements. The government will provide $10,000,000 of credit at the R.F.C. The manufacturers will each designate a single model of refrigerator, range or water heater to be sold as the "T.V.A. Special," or whatever it is called, priced low because it need not carry the usual expense for promotional advertising. The merchandise will be distributed through regular channels—wholesaler, dealer and utility sales department—and sold on a four-years-to-pay contract. The power companies will collect the installments with their monthly bills. The Electric Farm and Home Authority will discount the paper at a low rate at the banks, secured by the R.F.C. The dealers will accept a 50 per cent recourse and be paid in full. The householder will pay a carrying charge on his long-term contract of only 7 per cent instead of the usual 14 per cent or more because of the low cost of money and collection under the plan.

All this will be possible only because the government will undertake the development of the market, with an advertising, demonstrating and selling campaign set up for the long pull. It has never been tried before because every power company, manufacturer and dealer has always wanted immediate results. But now the plan is to launch a cumulative program designed gradually to convert the people of the Tennessee Valley area to a full use of electricity for comfort, labor saving and economy in the home and on the farm. It is recognized that it takes time to overcome the inherited traditions of families and change their methods of cooking, heating water and keeping foods. The first year's result may be small. But the campaign is to continue, expecting a steadily increasing return as the idea takes hold.

The power companies of the area are to be complimented for entering upon this program wholeheartedly, despite their conviction that this government power project is all wrong. Since it is to be, they are wise in facing the fact that the salvation of both T.V.A. and the local utilities will depend upon a thorough development of the market. The entire industry will watch this effort with keen interest and wish it well.

Logical and reasonable start in the Tennessee Valley

Many pessimists feared that the excursions of the government into the utility field would be incursions and thus mere raids. Well, actually, in the T.V.A. case it transpires that an agreement could be and has been reached which leaves honor on both sides and a considerable measure of equity all around. The utilities of the Commonwealth & Southern Corporation group do not find their areas pre-empted and their investments completely destroyed. The authority is buying these properties in more than twenty county areas in Mississippi, Alabama and Tennessee at prices which, however, are considerably below the replacement value set upon them by the utilities. Competition is either wholly eliminated or strictly curbed. T.V.A. gives assurance that it will aid in municipal acquisition of certain distribution systems at fair prices.

Along with this goes the clearing up of the Muscle Shoals power disposal. The utilities are assured 20,000 kw. and as much more of the surplus as they require. Meanwhile, at other points T.V.A. can take up to 70,000 kw. while waiting for power from Norris Dam. If the Southern companies can use it economically they can have some Shoals power at from 1.08 to 3.6 mills plus a demand and rental payment of $16,200 a month. On the other hand, T.V.A. gets its power at the same rates as soon as it has a load. All these interchanges are strictly interchanges and not separate

transactions for resale, and therefore the right of T.V.A. to dictate the ultimate resale price is definitely relinquished.

Rates in Tennessee are to be brought to levels comparable with those in Alabama and Georgia. A promotional rate is instituted which in three years will completely supplant the alternative rate now promulgated with it. This aims to lay the foundation for co-ordinated efforts to give appliances in T.V.A. and contiguous territory the chance they have hardly ever had before. The yardstick is being used to measure the proving ground. It's a fair and equitable contract and both sides have earned the right to credit for getting together promptly and avoiding what might easily have been a horrid mess and a vicious precedent.

Price fixing out

General Johnson apparently has very positive ideas on "arbitrary price fixing on the products of an individual manufacturer by a jury of his competitors." This comment from him came in the N.E.M.A. code hearing when a price fixing amendment was submitted. As a matter of policy and considering both the interests of the public and the manufacturers, we also believe the proposed amendment should be rejected. Aside from the very difficult factual determination of what constitutes a fair price, it is a sound principle of business that progress results from fair competition and not from price agreements.

Under the code permission is given to do two things that prevent unfair price competition. The first is the provision that no manufacturer shall sell below cost. This provision needs clarification both as regards exceptions and as regards the method for ascertaining costs. The second is the provision that permits prices and discounts to be published and the enforcement of these prices for current order solicitations. This provision prevents price cutting for a given order. It also needs clarification and strengthening as well as a more direct mechanism to get enforcement. But if the N.E.M.A. code authority uses these two provisions intelligently there is no doubt that present business practices will be improved. Until these clauses are put into operation, however, there is no necessity for price fixing.

It is apparent from the hearing to date that instead of getting more powers than N.E.M.A. authorities desired they are more apt to get modifications desired by labor and the government. Labor demands have already been made at the hearing which, if granted, will cause a serious increase in expenses and complicate code operations. The electrical manufacturers obtained more in their initial code than perhaps any other industry. It should have been put into operation before attempts were made to get more power or privileges granted by the administration in Washington.

Distribution economy and costs

Utility executives and engineers will do well to focus attention upon the distribution system. Distribution costs make up a larger proportion of the cost of service than is generally appreciated and these costs are mounting in relation to other costs. And the present active plans for domestic load building will call for even greater capital expenditures and other cost increases for distribution.

Economic and engineering studies of distribution need the application of the best talents available in the industry and will result in large savings. But engineering methods applicable to power stations, transmission lines and substations are not the kind to apply to distribution. The task is more difficult as well as more important and embodies a knowledge of service and economics as well as equipment. It takes a better engineer to get results in distribution, yet in few instances has any attempt been made to get competent distribution engineering. This part of the system has been left to grow of itself and the resultant waste and inefficiency are not creditable to the industry.

Mass production measures and methods must be applied to distribution because of the large number of small units involved. Engineers of a different type of mind and personality must be used in distribution than those who specialize on the details of a single large construction project. A multitude of small units, a complicated yet scattered assembly and a large number of men must be treated with a mass production perspective and results must be had upon each dollar of expenditure. Tradition must be thrown overboard if the industry really wishes to make the enormous savings possible in an intelligent economic and engineering development of distribution. The time to start is right now.

Testing Bushings and Insulation by Power-Factor Method

By I. W. GROSS and H. E. TURNER
American Gas & Electric Company

"On Sunday morning, at 10:45, one of the bushings on our ——— breaker gave way and caused three of the other bushings to be totally damaged. The arc held on for some two or three minutes and the entire plant was shut down in order to clear same, causing an interruption to the entire system of approximately three minutes." So reads the report of a district manager. Fortunately this is not an ordinary occurrence, but it is failures of this type that have led to the development of a testing set which, together with the results of testing, is discussed in this article.

Insulation testing experience from 1929 to 1933 has convinced the authors of the value of such testing. More than 15,000 transformer and circuit breaker bushings and the attendant apparatus insulation have been tested. This article describes the test method and apparatus and gives the results of some of the first testing. A later article will cover the results of extensive periodic testing started early in 1932, from which much valuable information has been obtained.

FAILURE of insulation on certain links of an electric system, for example on those immediately adjacent to the bus, may result not only in interruption to service but also in extensive equipment damage. It is particularly important, therefore, to keep sound the insulation of those particular links in a system. Although it is common to inspect and test rather frequently certain components of the system, such as, for example, generators, cables, relays, etc., no satisfactory field test has, until recent years, been available for testing the insulation strength of such members as high-voltage bushings or other insulating parts of oil circuit breakers. Costly failures of bushings in service led to a search to find a satisfactory method of test which would meet field conditions and make it possible to find faulty insulation and remedy it before failure actually occurred. The solution to the problem has been found in the adoption of the method to be described.

Requirements of a satisfactory field test

The class of insulation causing most trouble from interruptions to service, damage to apparatus and excessive repair and servicing costs includes all apparatus bushings, but particularly oil circuit breaker bushings, and oil circuit breaker insulation generally. Consequently, it was decided to concentrate, at the start, on testing oil circuit breaker bushings and insulation and choose a method of test on this basis.

The various insulating paths where losses may occur in an oil circuit breaker are shown in Fig. 1. No practical method of test had been available for testing such insulation in the field except by using a d.c. instrument, such as the "megger." Although such an instrument has many useful applications, our experience has been that it could not be used to pick out trouble in high-voltage bushings unless such bushings were in a condition where failure was imminent. In some cases the d.c. method has failed to show a fault in bushings which were known to be punctured. It was clear it would not be useful for the analysis of the other insulation shown in Fig. 1. The test method desired had to be simple, positive, reasonably accurate and easily workable under field conditions. It had to furnish a reliable qualitative result from which insulation could be classed as good, deteriorated or bad, and the application of the test must not destroy or injure insulation or equipment being tested. From the test results it was necessary to localize the fault; that is, determine whether it was in the bushing, oil, lift-rod, bracing, etc., or caused by carbon deposits.

The portable insulation test set developed by the Doble Engineering Company, based on the power-factor and energy-loss method of testing, was the only device available which would meet the requirements. In this test set (Figs. 2, 3 and 4) the power-factor method of testing, the merits of which had been recognized for laboratory use, was made available in portable form for field use. Unlike a laboratory set, this portable set also measures energy loss directly. The test set comprises a fully shielded, voltmeter-ammeter-wattmeter scheme for measuring power factor which avoids the drawbacks of the conventional bridge circuits. It is portable, compact and rugged, which makes it adaptable to field conditions. It is simple to operate and gives positive readings from which reliable qualitative results can be consistently obtained. It is accurate beyond field requirements, constantly checkable in the field, and requires infrequent servicing. Most important of all, it provides the necessary data for localizing faults.

Insulation tested and method of making tests

Most of the testing done has been on oil circuit breaker insulation, including both the bushing and the breaker internal insulation. In addition, a considerable amount of testing was done on bushings in other apparatus, on

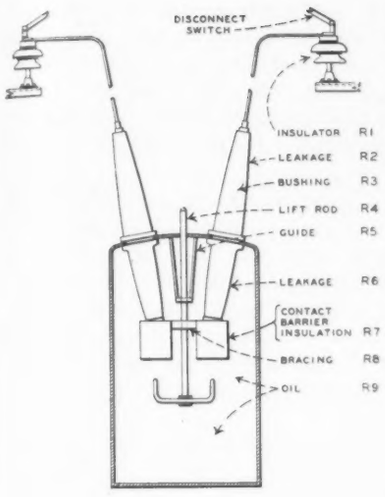
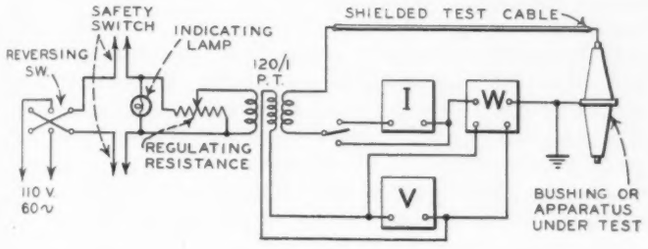


Fig. 1—Possible paths of energy loss in insulating members of circuit breaker

By measuring and comparing these losses with different circuit connections the condition of the various insulation can be determined. These measurements are easily obtained with the portable insulation test set shown in Fig. 3.

Fig. 2—Simplified circuit diagram of the insulation tester



Shows the conversion of the 110-volt, 60-cycle supply to a test voltage of approximately 10,000 volts. Indications of voltage, current and watts give the data on which the quality of insulation is based. Very effective guarding and shielding is provided to prevent interference from leakage currents and stray electromagnetic and electrostatic fields. Shield and guard circuits and other details are not shown.

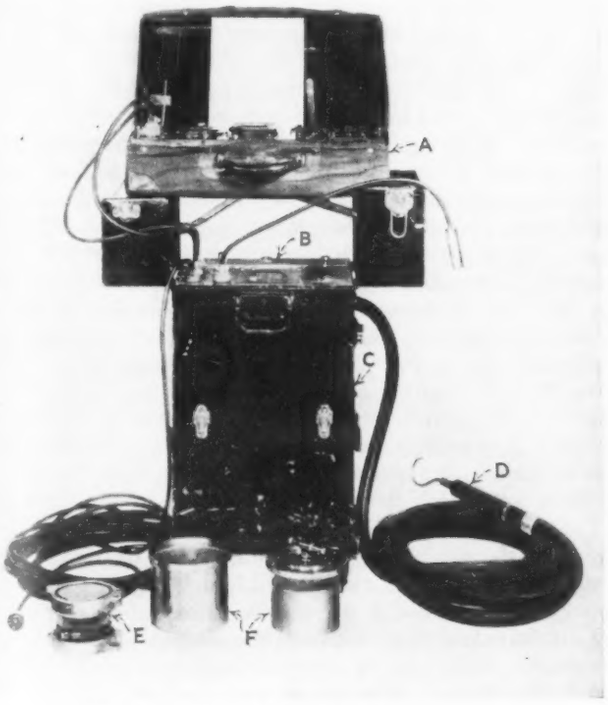


Fig. 3—Complete insulation test set

Includes instrument case (*a*), control panel (*b*), transformer (*c*), shielded cable (*d*) and calibrating condenser (*e*). A special test cup (*f*) for oil tests is shown in the foreground. Note portability and compactness of set.

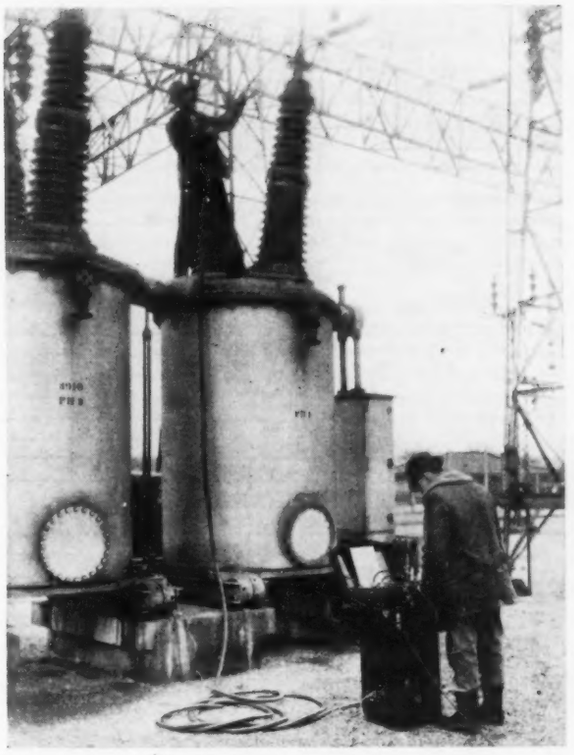


Fig. 4—Field set-up of insulation tester

Making ready to test the bushings in a 132-kv. oil circuit breaker. The test set is transported in a light, specially fitted truck and is frequently used without removing it from the truck where field conditions permit driving the latter close to test location.

transformer windings (particularly instrument transformer windings), on carrier-current coupling capacitor insulation, on wood-insulating members (oil circuit breaker lift-rods, guides, bracing and hot-line sticks), on insulating oil and on bus insulators.

The apparatus to be tested, for example, an oil circuit breaker, is first cleared by opening the breaker and the disconnect switches. The test equipment is set up and connected (Fig. 4) to the supply. The shielded test cable is connected to the bushing to be tested, and when the safety switches in the supply line are closed voltage is applied and raised to 10 kv., at which point readings of current, watts and voltage are made and recorded. From these readings the power factor is calculated. When necessary a guard is placed on the bushing to eliminate the effects of surface leakage. After each bushing has been tested separately, the bushings in each phase are tied together by closing the breaker and another set of readings is taken. These are used in determining what other insulation in the breaker may be defective besides the bushing insulation. Usually it is not necessary to disconnect the leads from the bushings to the disconnect switches and supporting insulators.

From an analysis of all the above readings and the calculated power factor, the location of trouble, if present, can be determined and segregated as described later. Trouble may be in the bushings themselves, in the wood or composition breaker insulation external to the bushings, in the tank oil, in the bus insulators, in carbonized leakage paths over insulating members, in disconnect switch insulators, or in a combination of these.

The speed with which testing can be done depends

Sheet No. 133

DOBLE ENGINEERING COMPANY

OFFICE AND LABORATORY
MEDFORD HILLSIDE
BOSTON, MASS.

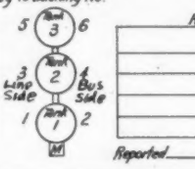
TESTS MADE FOR Indiana & Michigan Electric Co. DATE 6/14/32
NATURE OF TESTS O.C.B. Insulation TEMP 74°F – 65%
LOCATION OF TESTS Berrien Springs Hydro. WEATHER Sunshine

O.C.B. Dowagiac
Mfgr. & Type —— G.E. WEST. CONDIT
Kv. Rating 37 Current Rating 400 Age in Years
Type of Bushing Condenser ☐ Porcelain ☐ Compound Filled ☒ Oil Filled ☐

REMARKS

Reported That "Crackling" Around #1 Bushing Could Be Heard After Storms

Key to Bushing No.



REMARKS

Reported 193_ To

Bushing No.	Bushing Serial No.	Side	Phase	Meter Reading Amps.	Meter Reading Watts	Kv.	Microamps	Watts	% P.F.	P.F. Bushing in Parallel Corrn.	P.F. Bushing in Parallel Watts	P.F. Bushing in Parallel % P.F.	REMARKS	
1		L	3	12.5/3	2.05	10	1020	2.04	20.0	6	1	R		O.C.B. Open
2		B	3	13.5/3	.355	10	1100	0.35	3.2	8	2	G		
3		L	2	11/3	.82	10	900	0.81	9.0	6	1	R		
4		B	2	11.5/3	.335	10	940	0.33	3.5	8	2	G		
5		L	1	11/3	.255	10	900	0.25	2.8	6	1	G		
6		B	1	11.5/3	.245	10	940	0.24	2.6	8	2	G		
Bank 1			3	24.5/3	2.48	10	2160	2.45	11.4	14	3			O.C.B. Closed
Bank 2			2	22.5/3	1.04	10	1840	1.01	5.5	14	3	ID		
Bank 3			1	22.5/3	0.445	10	1840	0.42	2.3	14	3			
OTHER TESTS														
1		L	3	10.5/3	2.17	10	860	2.16	25.0	0	0	R	Bus Disconnected From Bushing = Guard On Bushing	

G = Good Bushing. XD = Fault External
R = Removed Bushing. To Bushing

Fig. 5—Typical test sheet for recording field data

This particular sheet shows two bad bushings found by test. They have been marked for removal (R). Also one faulty condition has been located in tank 2. Note, it has not been necessary in this test to remove the leads to the bus to detect the bad bushings in this case.

upon how the test program is carried on. Where no attempt is made at the time of the tests completely to locate and segregate trouble, a two-man crew—the set operator and an assistant handling the test cable—can test, under favorable conditions, up to twenty breakers in one day. We have found it preferable, wherever possible, completely to run down the trouble, if at all serious, at the time of test. Since this may involve dropping tanks or draining oil from the large breakers the number of the breakers tested per day will depend upon the conditions encountered. Wherever it can be done, the operator of the test equipment works along with the regular maintenance crew on a schedule mutually worked out; a defective breaker can in this way be completely reconditioned and its condition rechecked before it is left.

Data gathered and its meaning

A good understanding of the significance of the data gathered is necessary if the proper interpretation is to be made and any worth-while result arrived at. The fundamental quantities—amperes, watts and volts—are measured and the power factor calculated from them. The current is a combination of the capacity or charging current with the energy-loss current of the insulation under test. In normal insulation the energy loss current will be very small compared to the charging current, while for deteriorated or bad insulation it will be larger. The watts represent the loss in the insulation caused by current flowing through the resistance of the leakage path. In a good bushing, where the leakage is small, the per cent power factor will be low and the watts loss low. As leakage current increases both the power factor and the watts loss will increase. In addition to the calculated power factor the indicated watts loss reading is very important in determining the condition of the insulation.

In using the power factor values as a criterion of bushing condition it is necessary to set up a tentative standard for the various types of bushings. Such a standard cannot be hard and fast and must be arrived at on the basis of good judgment and experience. The values given in Table I have been used in our testing work subject to some slight modifications under certain conditions, and subject also to the additional check of watts loss reading.

The test set can be used equally well on elements of breaker or other insulation as on a complete bushing or piece of equipment, and watts loss, amperes and power factor values can be obtained as a basis for judging the quality of such insulation elements. For instance, voltage may be impressed across short sections of wood insulation and composition insulating tubing. From results of such tests the insulation resistance of the section can be calculated. The effective insulation resistance is, of course, equal to E^2/W and has been found very useful in determining the condition of insulating members. The normal insulation resistance of a good wood lift-rod is about 2,000 megohms; for bad lift-rods this resistance has been of the order of 15 megohms for a 3-in. section.

Tracing down trouble indicated by tests

Trouble in the breaker insulation structure shown in Fig. 1 may be found by making three sets of readings for each tank of the breaker. A set of readings is taken for each bushing alone, with the breaker contacts open. The power factor and watts loss obtained apply to a combination of insulation which includes the disconnect insulator, the bushing, the contact barrier insulation, the tank oil, and wood bracing, if any, between the bushings. The third set of readings is taken with the breaker contacts closed, which ties the bushings in parallel, and these readings are used to determine whether the wood bracing or the lift-rod insulation is defective. This is done by comparing the watts-loss reading for the two bushings in parallel with the sum of the watts loss taken for the individual bushings. With the breaker contacts closed no potential exists across the brace rod and no loss can occur in it. Therefore, if the watts loss taken from the combination reading is approximately equal to the sum of the individual readings, there is no electrical defect in the cross bracing or the lift-rod. If the watts loss from the combination reading is less than this sum, there is a loss which indicates a defect in the bracing, but if greater than this sum, there is a defect in the lift-rod. If the readings for the individual bushings, i.e., both watts and power factor, are high compared to what they normally should be, the location of the trouble can be found by a process of elimination. The lead to the bus insulator can be disconnected and the insulator's effect eliminated. The oil in the breaker tank can be lowered to take away its effect. The contact barrier insulation can likewise be removed. If the loss in the bracing is high the bracing can be removed. If there are conducting accumulations over the outside bushing sur-

faces these surfaces can be cleaned. The trouble can in this way be located.

The condition of the oil in the tank can be further determined by a direct test. Wherever there are indications of bad oil or excessive leakage loss in the internal breaker insulation the breaker should be opened up and a thorough inspection made for carbon deposits. In such cases the wood bracing and other members can be removed and tested separately.

If trouble is traced to the bushing itself a further process of elimination may be tried to locate the defect. Both top and bottom ends of the bushing should be guarded to eliminate the effect of outside surface leakage. If trouble still exists the oil should be tested, in the case of an oil-filled bushing, and removed if necessary. If the trouble is in the solid insulation of the bushing the bushing can be disassembled and the individual parts tested to locate the trouble. If the wound insulation or composition barrier tubing is indicated as defective this can be checked by an individual test on these elements of insulation.

When the bus insulator has been disconnected from the bushing it can be tested separately.

In general, it is preferable in testing transformers to disconnect or isolate the bushings from the transformer windings and test the bushings and winding separately. This is practically necessary on large transformers to locate the trouble accurately. Since it is difficult under field conditions to do this in every case an over-all test on instrument transformers has been made use of which gives very satisfactory results. Limits of power factor and watts loss have been set up as a guide in making such tests. These, together with some of our test results, will be given in a subsequent article.

In testing wood and composition insulation criteria have been established to serve as a guide. These are based on the insulation resistance calculated from the readings of current and watts taken on short sections of insulation. The effective value of the insulation resistance (E^2/W) is used to determine the quality of the insulation.

Oil circuit breaker tests in 1929

The first tests with the insulation tester which we made were conducted in 1929 and covered a large number of the oil circuit breaker bushings on the American Gas & Electric Company system. The bushings tested ranged in voltage from 15 to 132 kv. and the tests covered most thoroughly bushings of the solid type with which a considerable amount of trouble had been experienced. A number of oil-filled bushings at 132 kv. and lower voltages were also tested. In Table II a summary is given of the results of these tests.

Troubles were classified in two ways: Faults in the bushing itself were designated as "B" faults and faults external to the bushings as "X" faults. Of a total of 3,881 bushings tested 1.5 per cent represented "B" faults and 1.65 per cent represented "X" faults. Since this method of testing was new, and these were pioneer tests, care was taken to be conservative in setting limits and in passing judgment. This is one of the reasons why the per cent of faults marked was low compared with those from the 1932 and 1933 tests. Another reason was lack of knowledge of all that the test has subsequently been found capable of showing. Recommendations were made for removal of external troubles as they were found and for the removal of all bushings in the dangerous class. Others classed as doubtful were recommended for reconditioning and watching.

Steps were taken to remedy the faulty conditions found and in the case of the dangerous bushings to remove them. No rechecks were made to determine how effective the servicing had been in removing the conditions. Over a period of about a year and a half subsequent to the tests thirteen bushings of the total of 58 found defective during the tests, or 23 per cent, failed in service. Two bushings in the removal class failed within a few days of the tests before they could be taken out of service. The results of the 1929 tests showed definitely the practicability and need for doing further testing. The next testing of any extent was started in 1931, when tests were made on a large group of 44-kv. transformer bushings.

44-kv. transformer bushing tests in 1931

An epidemic of transformer bushing failures on the 44-kv. system of one of the operating companies in 1930 resulted in a decision to test these bushings in 1931 to find out the cause.

The only available instruments for these tests at that

Indiana & Michigan Electric Co.

LOCATION: Fort Wayne SS.- 132 KV. Transf. #1 ___ Line, Bank.

APPARATUS: O.C.B. ~~TRANS~~ ___ 132 Kv. ___ Type, Kva.

BUSHING: Make ___ Type O.F. Amps. 600

POWER FACTOR AND MICROAMPERES 4 yrs. Old (6/24/32)

DATE	SHEET	φ_1 - B	φ_1 - T	φ_2 - B	φ_2 - T	φ_3 - B	φ_3 - T	REMARKS
6/24/32	189	810 R-XD 5.5-0.45	810 D-XD 4.7-0.38	860 R-XD 7.9-0.68	810 R-XD 8.5-0.69	860 3.4-0.30	770 2.9-0.22	
11/18/32	189 A	840 3.2-0.27	800 2.4-0.19	800 3.0-0.24	800 3.1-0.25	800 1.4-0.11	800 1.4-0.11	Serviced 7/32
11/23/32	1-70	(837) (15) 0.14	815 1.2-0.10	837 2.4-0.20	837 3.2-0.27	815 1.2-0.10	815 1.2-0.10	

Watts
Power Factor
Current

Fig. 6—Office record of power factor tests on a 132-kv. breaker

The three "Remove" (R) and one "Defective" (D) bushing faults, as well as three faulty conditions external to the bushings (XD) have been cleared up by servicing the breaker as shown by the later tests recorded on the card.

Table I—Rating of Bushing Quality by Power Factor Indication

	Power Factor Limits for Different Type Bushings			
Bushing Condition	Oil Filled %P. F.	Condenser % P. F.	Solid Insul. % P. F.	Porc. Only %P. F.
"G" Good	0-3.5	0-3.5	0-4.0	0-4.0
"D" Deteriorated	3.5-5.0	3.5-5-0*	4.0-6.0	4.0-6.0
"R" Bad (Remove)	Above 5.0	Above 5.0	Above 6.0	Above 6.0

*For old bushings on less important locations use 3.5-6.0.

Table II—Results of 1929 Power-Factor Tests on Oil Circuit Breaker Bushings

		Per Cent
Total bushings tested	3,881	....
Total faults found	122	3.15
Bushing faults	58	1.50
External faults	64	1.65

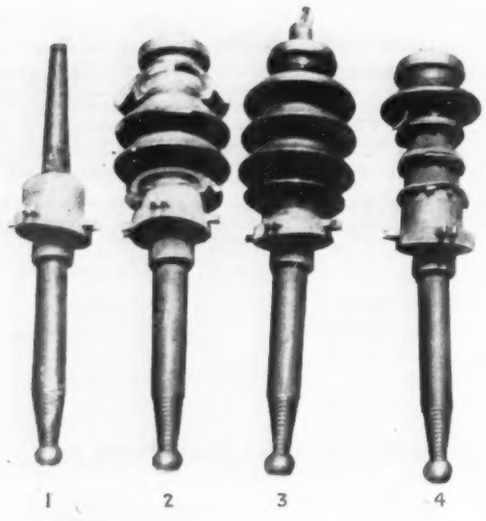


Fig. 7—Four 44-kv. bushings tested with d.c. instrument and power-factor method

The power factor tests (Table III) showed all bushings as defective; the d.c. test completely missed picking three defective bushings. Power-factor tests on No. 1, as the bushing was being torn down, proved moisture had got into the insulation.

time were the d.c. instruments of the "megger" type and the Doble insulation tester. The value of the d.c. instrument in determining the relative condition of bushings had, up to this time, been rather uncertain, although its ability to pick out very bad bushings in some cases was recognized. In view of our satisfactory experience with the insulation tester on some 4,000 bushings in 1929 it was felt that this instrument was better suited to the purpose at hand. More thoroughly to compare the d.c. test method and insulation tester some hundred or more tests were made using both methods on a group of transformers and bushings not in service (spares and bushings which had already failed in service). The results of several typical tests are given below:

The group of bushings shown in Fig. 7 tested as shown in Table III. No. 1 bushing was shortly before a physically intact bushing in a spare transformer. As the bushing initially showed a power factor of 8.2 per cent, but a megohm reading 10,000 when in the transformer, it was torn down step by step, much against the best judgment of the maintenance man, and carefully examined. The twelve insulating condenser layers from the stud to the ground flange showed power factors ranging from 6.9 to 15 per cent and the cushioning felt between adjacent porcelain shells was found soaked with water.

Two of the other questionable bushings tested showed power factors of 12.5 and 23.0 per cent with d.c. readings of 10,000 and 450 megohms respectively before noon and 3,000 and 100 megohms some two hours later. All the above d.c. tests were made with a borrowed 2,000-volt, 10,000-megohm instrument. Although some bushings tested in this preliminary investigation showed both low power factor and high insulation resistance, we had convincing proof that the insulation testing set could detect serious faults in bushing insulation not possible with the d.c. instrument. Therefore we adopted this insulation test set for our intensive investigation of the 44-kv. bushings in question and also made duplicate megger tests with a 500-volt, 1,000-megohm instrument, which was available, to see just how bad a bushing had to become in service before the d.c. test would pick it out.

In all, some 450 44-kv. transformer bushings were tested under conditions where the bushing was both connected to the transformer winding and where it was isolated by dropping the bushing lead inside the transformer tank. The results of tests on 443 of these bushings are summarized in Fig. 8. On the basis that bushings of this type having power factors of 3.5 to 5 per cent were defective, and above 5 per cent should be removed, 50 per cent of the bushings were found defective and 28 per cent should have been removed. This badly deteriorated condition of these bushings followed the past trend of bushing failures, which was 40 bushings (9 per cent) in 1930 and 24 (6 per cent) in 1931 up to the first of August. While a bad condition due to moisture absorption was suspected in those bushings of a type having the multi-skirt porcelain compounded, and in some cases cemented together, no good reason appeared for the high percentage of "deteriorated" and "remove" bushings in the one-piece porcelain class. Therefore, several bushings of the three types were sent to the manufacturer's laboratory for investigation and tested with the following results:

Laboratory check tests on 44-kv. bushings

Seven bushings in all were tested in the laboratory. The results of these tests (Table IV) showed conclusively:

(a) That power factors in the order of 5 per cent and above on the older type of bushings indicated defective bushings.

(b) In the new type one-piece porcelain bushings the high power factor was found to be due to defective insulation in the outer condenser layer. (This was found on the detailed analysis.) The reason why these bushings (I and II) did not break down on test was that enough good insulation still remained to resist puncture.

(c) Insulation resistance measurements on a bushing which has failed (punctured) may be high, in two cases (III and VI) being infinity by the d.c. test. On field tests the d.c. insulation

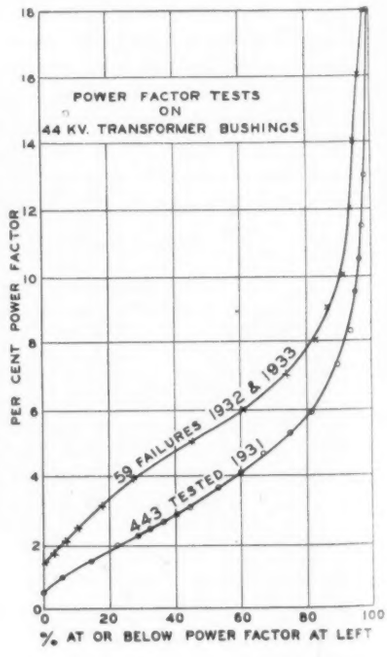


Fig. 8—Power-factor tests on 443 44-kv. bushings showing over 50 per cent deteriorated

For economic reasons these bushings were not removed on the basis of these tests. During the two years immediately after these tests 59 of these bushings failed in service. Most of the failures occurred on bushings showing high power factor when first tested. The power factor at the time of failure, however, was undoubtedly considerably higher.

Table III—Comparative Tests on Bushings by the D.C. and Power-Factor Methods

(Refers to Fig. 7)

Bushing	No. 1	No. 2	No. 3	No. 4
Megohms (by d.c. instrument)	10,000	450	2,000	10,000
Power factor (per cent) (by insulation test set)	8.2	23	22	12.5

Table IV—Special Tests on 44-Kv. Bushings Found Defective by Power-Factor Field Tests

		Field Tests				Factory Tests			
						Kv.		Kv.	
Bushings		%		Meg-		60		Im-	
No.	Class*	P. F.	Watts	ohms[7]	P. F.	Cycle	Time	pulse[8]	Remarks
I	A	4.6	0.25	Inf.	6.43	190	0	400	OK[9]
II	A	6.2	0.305	Inf.	8.6	180[1]	0	438	OK[9]
III	C	5.5	0.76	1,000	4.65	160[2]	..	...	Broke down
IV	B	5.8	0.45	1,000	3.75	175[3]	0	410[4]	Broke down
V	B	8.0	1.13	900	3.7	185	..	...	Broke down
VI	C	9.5	1.93	Inf.	....	60[5,2]	..	...	Broke down
VII	B	10.5	1.42	500	3.55	190	0	350[6]	Broke down

[1]Also 50 kv. for 1½ hours O.K. and 60 kv. 1 hour O.K.

[2]Insulation resistance after breakdown showed infinity.

[3]Also 50 kv. for 1½ hours O.K. and 60 kv. 1 hour O.K.

[4]Insulation resistance after impulse breakdown. 900 megohms then on 60-cycle test broke down at 55 kv.

[5]Broke down at 60 kv. after ¾ hour.

[6]Insulation resistance after impulse breakdown, infinity, with 5,000-megohm, 1,000-volt instrument.

[7]1,000-megohm, 500-volt instrument; field test.

[8]Crest of 1½x40 impulse wave.

[9]Bushings Nos. I and II were found to have defective insulation next to the mounting flange, although enough good insulation probably remained in the bushing for satisfactory service.

*A — one-piece porcelain water-shed (new type); B — four-skirt, multi-piece porcelain cemented together (old type); C — four-skirt multi-piece porcelain compounded together (aged type).

resistance failed to give positive indication of deteriorated bushing condition.

(d) The 60-cycle flashover test on a bushing is not an infallable criterion of the suitability of a bushing for service. (Two bushings having high power factor withstood 60-cycle flashover, but failed on impulse test.)

That high power factor is indicative of poor bushings is shown by the curve of failures in Fig. 8. This curve shows that 59 bushings (12.5 per cent) have failed in service since these tests were made, and that 33 of these (56 per cent) had power factor above 5 per cent. It should be noted that no servicing was done on these bushings after test, the bushings being left as found, since the economics in this particular case did not permit of wholesale bushing replacements. The majority of bushings shown defective on this field test have undoubtedly absorbed moisture, as proved by the detailed test. The new type bushings, while defective on account of design, are still serviceable due to the large factor of safety in the initial design. The power-factor test, however, was capable of finding these defects.

Continuous testing program for bushings and other insulation

The results from the testing outlined above made it seem more desirable than ever to adopt a regular routine testing program for bushings and apparatus insulation for the whole system. Such a program was decided upon and started early in 1932. One test set was used in full-time operation and recently a second test set has been added. Tests have been made on bushings, oil circuit breaker and transformer internal insulation, coupling capacitors, bus insulators, wood and oil. The results of these tests will be given in considerable detail in a later article.

Quick Check on Fusing Value of Copper Wire

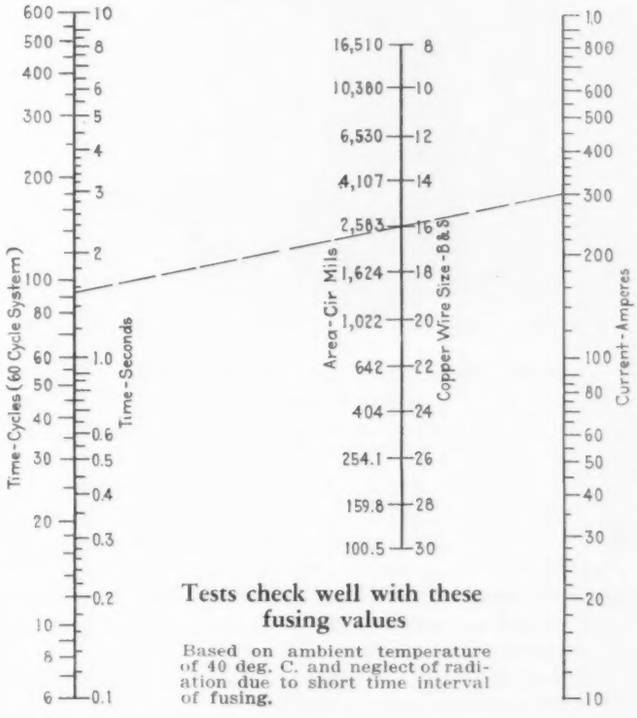
By W. B. MORTON
Philadelphia Electric Company

The use of copper wire as a fusible link in applications such as an operating element for a fire protective scheme depends upon the current-carrying capacity and fusing current-time characteristics of copper wire, which are expressed in the formula by S. M. Onderdonk*:

$$33\left(\frac{I}{A}\right)^2 S = \mathrm{Log}_{10}\left(\frac{t}{274}+1\right)$$

in which:

I = current in amperes.
A = cross-sectional area of conductor, c.m.
S = time current is applied, seconds.
t = temperature rise of copper, deg. C.



Tests check well with these fusing values

Based on ambient temperature of 40 deg. C. and neglect of radiation due to short time interval of fusing.

In the calculations of fusing time-current characteristics upon which the nomograph is based the following assumptions are made:

(a) Melting point of copper, 1,083 deg. C.
(b) Ambient temperature, 40 deg. C.
(c) Resistance of copper, 1.589 microhms per cubic centimeter at 0 deg. C.
(d) Radiation is neglected due to the short time interval of fusing.
(e) Temperature coefficient of copper at 0 deg. C., 1.234.

Fusing time-current values may be taken directly from the nomograph. Time is given both in cycles (60-cycle system) and seconds and the current values cover the range in which copper wire in these sizes ordinarily finds an application. Tests have been made which indicate a good agreement of actual and computed values.

*"*Short Time Current Carrying Capacity of Copper Wire*," E. R. Stauffacher, General Electric Review, June, 1928.

Transformer Proofed Against

BY H. V. PUTMAN
Manager Transformer Engineering Department,
Westinghouse Electric & Manufacturing Company

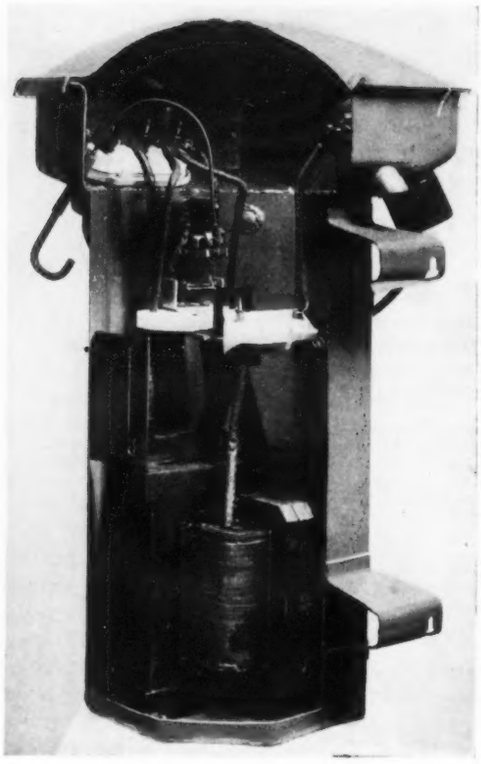


Fig. 1—Deïon gaps and AB breaker in transformer case
The external handle permits reclosing of breaker without removing transformer cover.

CAN a distribution transformer be made completely self-protecting, burnout proof, and so impervious to lightning that it can withstand a direct stroke to the primary lines right at the transformer without even a service interruption? Only a few months ago the answer would easily have been "No." But today the results of tests on a newly designed transformer make an affirmative answer probable. Replacement of fuse cutouts with a thermally operated circuit breaker inside the case of the new transformer makes possible refinements in the Deïon gap to discharge the heavy lightning currents associated with direct strokes. The thermally controlled circuit breaker gives the transformer other valuable characteristics which prevent burnouts and protects against short circuits and cumulative overloads, permitting without hazard a higher ratio of connected load to transformer capacity. By practically eliminating maintenance expense and simplifying installation through the elimination of all separately mounted protective devices the cost of the new transformer is actually lower, both installed cost and in operating cost, than a standard transformer with its associated arresters and cutouts.

In the first place the windings of the transformer must be protected against surge voltages beyond their safe impulse strength; second, there must be provided a path to earth for the lightning of sufficient carrying capacity to conduct safely the tremendous currents of direct strokes. Field experience and laboratory tests have demonstrated that all conventional distribution protective devices explode immediately when subjected to the surge current of a direct stroke. Even a moderately high surge current is sufficient to blow a 10-amp. fuse link. Obviously, if service interruptions are to be eliminated, there can be no fuse links, nor any conventional protective devices, in the lightning path.

Direct strokes handled with resistor eliminated

However, laboratory tests proved that with slight refinements Deïon gaps could handle the tremendous currents of direct lightning strokes if the resistor ordinarily used in series with it in the surge-proof distribution transformer could be eliminated. The only function of the resistor is to reduce the power follow current through the gap which might otherwise blow fuses. By substituting a small Deïon circuit breaker for the conventional fuses service interruptions due to fuses blown by the lightning current are eliminated and the Deïon gaps discharge the direct stroke currents safely to earth, at the same time limiting the surge voltage across the transformer insulation to a safe value.

The circuit breakers (type AB) used for this application appeared to possess ideal characteristics for use in the transformer. An investigation of their service record over a period of several years disclosed remarkable reliability; in fact, even better than that of distribution transformers. Therefore the breakers are mounted inside the tank, an arrangement resulting in several desirable operating characteristics which cannot be obtained with an externally mounted breaker.

In the smaller sizes, where the breaker is connected in the secondary circuit, protective links are used inside the tank in the connections to the primary winding. Their only function is to protect against a feeder outage in the remote possibility of an internal fault in the winding resulting from some hidden defect. In this location they are not in the path of the lightning current so they can open only from an internal winding fault, which would require a major repair to the transformer.

No interruption with 20,000,000-volt stroke

The claim of this design to complete immunity from lightning rests on the proposition that the Deïon gaps are able to discharge the currents associated with direct strokes. Dr. C. L. Fortescue has calculated the surge current which would pass through the Deïon gaps if the primary lines were hit by a 20,000,000-volt stroke right at the transformer, and the surge current carrying capacity of the Deïon gap is well above his calculated figures. Based on transmission line experience, a stroke

Lightning and Overload Burnouts

of this severity should be experienced very rarely indeed. Laboratory demonstrations have been made, before various groups of engineers, in which a transformer fully excited and loaded was subjected to surges considerably in excess of Dr. Fortescue's figures without even a service interruption. In spite of such apparently conclusive tests, the final pronouncement of the success of this new development must await the verdict of field experience. Whether or not the goal has been completely attained remains to be seen, but the laboratory tests seem to leave little doubt that the service record will be far more favorable than any past operating experience.

Operating engineers inspecting this new transformer have been keenly interested in the functioning of the circuit breaker. It may therefore be of interest to examine briefly the characteristics of a transformer equipped with a circuit breaker having thermally responsive tripping elements. As employed in the transformer, the thermal elements of the breaker are immersed in the transformer oil, where they are heated both by the oil and by the load current which flows through them. So arranged, it is possible to make the breaker operation depend not on the oil temperature alone but rather on the copper temperature. This is scientific protection, because it is the insulation in contact with the copper which it is desired to protect against dangerous temperatures. It is apparent that this important advantage could not be obtained so readily or so completely should the breaker be installed outside the tank.

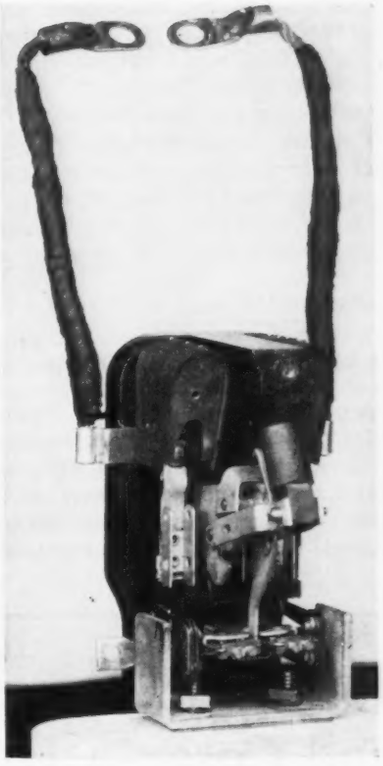


Fig. 2—The AB breaker actuated by thermal trip

It is trip-free of the handle and can be closed against dead short circuit with perfect safety. Three hundred thousand identical mechanisms are in service in "Nofuze" panels and load centers.

To make the breaker depend on the copper temperature for tripping, its thermal elements are so designed that the temperature difference between elements and oil increases or decreases with changing load in a manner proportional to the change in the gradient of the transformer winding itself with respect to the oil temperature.

Furthermore, since higher loads are permissible with lower ambient temperatures, the breaker by proper design of its thermal elements may be made to adjust automatically the permitted safe load for a decrease in ambient temperature. The breaker opens whenever its thermal element reaches the tripping temperature for which it is designed. With a lower ambient, there is a lower oil temperature for a given load, and this operates automatically to permit a higher transformer current before the thermal elements reach their tripping temperature. By correctly proportioning the thermal elements, this reduction in oil temperature, caused by lower ambient, can be made equal to the increase in the temperature of the thermal element caused by the allowable increase in transformer load.

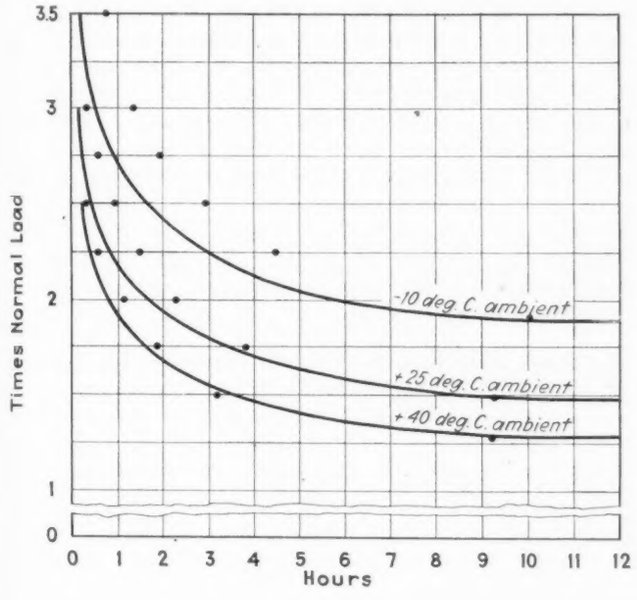


Fig. 3—Heavier overloads permitted at lower ambients

Full lines indicate the loads required on a small transformer to produce 150 deg. copper temperature at different ambient temperatures. Dots indicate breaker operations. Data are for 10-kva., 2,400-volt transformer. In general, breaker limits copper temperature to 105 deg. C. A slightly higher temperature may occur under the condition of a high overload applied to a cold transformer at very low ambient temperatures. But the duration is short and the temperature amply safe for the insulation. If the overload is applied to a warm transformer at low ambient temperature, the copper temperature would not appreciably exceed 105 deg. C.

In practice, the above requirements may not be exactly met in the design of the thermal elements, but in the smaller distribution transformers practically complete ambient temperature compensation is obtained. The curves of Fig. 3 illustrate typical overload characteristics and the ambient temperature compensation obtained in a small distribution transformer.

It is apparent from Fig. 3 that the breaker permits the transformer to carry any useful short time overload, opening the circuit only in case dangerous copper temperatures are reached. For currents above the useful range for temporary overloads and up to short circuit rapid

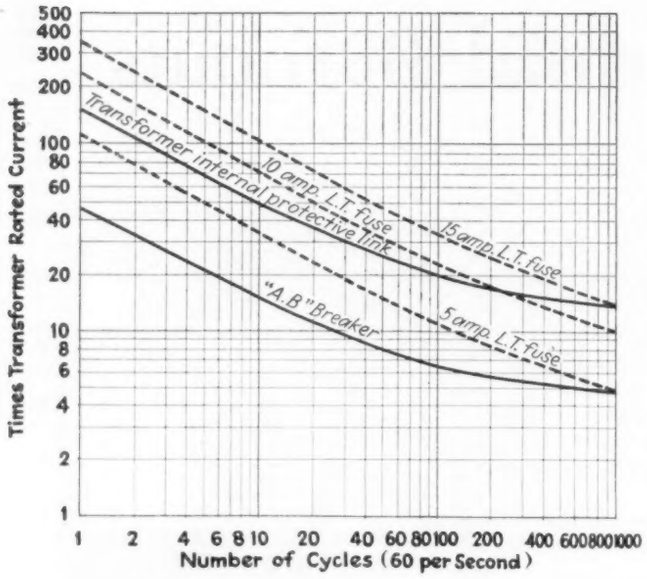


Fig. 4—High current characteristics of breaker and protective links

With a short circuit current of 30 times normal breaker would trip in 2½ cycles.

operation of the breaker is desirable for two reasons: First, it minimizes the duty on the breaker itself; second, it facilitates co-ordination with feeder fuses and station breakers. In practice, immediate tripping of the breaker will take place with currents in excess of about five times normal because these high currents are sufficient in themselves to raise the temperature of the breaker thermal elements to the tripping point without waiting for the transformer oil to heat. Within the useful overload range the relatively long time which the breaker permits a given overload to be carried is due to the fact that the breaker must wait for the oil to heat up before it can trip. Within the high current range where high-speed operation is essential the characteristics of the breaker are ideal, being very much faster than conventional fuse links. Fig. 4 illustrates the high-speed characteristics of the breaker and also of the protective links employed in the smaller sizes.

With the increasing use of major electric appliances, such as refrigerators, ranges and automatic furnaces, utilities are placing more and more stress on the importance of the continuity of electric service in the home, not only in cities but in the suburban and rural districts as well. It is confidently believed that this new development will greatly assist the utilities in obtaining this essential service continuity, thereby establishing increased confidence in the dependability of electric service and extending and expanding the use of electricity in the home.

Relation Between Outputs and Costs in Hydro Plant

Because the operating expenses and charges of many hydro-electric plants are comparatively inflexible it naturally follows that the over-all cost per kilowatt-hour generated in a given period is likely to drop off rapidly with a rising output. Therefore, so far as system conditions permit, it is economically desirable to utilize hydro generating capacity liberally over the course of a year within the limitations of each situation. An excellent example of this is the experience of the United Electric Light Company, Springfield, Mass., in the operation of its Indian Orchard station on the Chicopee River.

The station has a total rating of 6,125 kva., its generating units consisting of one 1,875, one 2,750, and two 750-kva. machines. The plant investment in 1932 was $644,758, or $105 per kva. It delivers energy into the United's local system, generating at 5,500 volts, and in 1932 generated a total of 15,398,600 kw.-hr. at an over-all cost of $204,753, or 1.33 cents per kilowatt-hour. Interest on the investment was figured at 6.418 per cent and the operating costs and charges were nearly evenly divided throughout the year. For the twelve months operating expenses figured 6.7 mills per average kilowatt-hour generated and fixed charges 6.6 mills. No very great variation occurred in the total monthly costs during the year, the highest being $17,933 (in March) and the lowest $16,570 (in October). However, the variation in monthly outputs, and consequently the unit costs, was striking, as may be seen in the accompanying table.

These outputs showed a ratio of 6.7 to 1 between the maximum of 2,759,200 kw.-hr. in April and 384,200 kw.-hr. in August. The resulting total cost per kilowatt-hour varied from 6.6 mills in April to 4.37 cents in July (August was 4.35 cents). During the summer the river flow falls off sharply and there are no great storage reservoirs on its watershed comparable to some of the other rivers of New England. The United company is tied into the Connecticut Valley Power Exchange through its connections with the Turners Falls Power & Electric Company system and has been able to shut down its steam plant in Springfield for months at a time, depending on purchased energy and the output of its own hydro facilities to handle its loads. These figures show the desirability of intensive use of the hydro plant when conditions permit—a practice that the management followed within the limiting conditions.

Economic Results at Springfield Hydro Plant, 1932

Indian Orchard Station

From data presented before the Massachusetts Department of Public Utilities.

Months	Kw.-Hr. Generated	Total Cost Cents Omitted	Cents per Kw.-Hr.
January	1,946,200	$17,169	0.88
February	1,643,600	17,055	1.04
March	1,790,600	17,933	1.00
April	2,579,200	17,108	0.66
May	1,261,800	16,887	1.34
June	532,900	17,130	3.21
July	387,300	16,917	4.37
August	384,200	16,715	4.35
September	442,800	17,204	3.89
October	1,123,500	16,570	1.47
November	2,045,100	16,932	0.83
December	1,261,400	17,128	1.36
Total	15,398,600	$204,753	1.33
Operating Expenses		102,786	0.67
*Fixed Charges		101,967	0.66

*Charges include municipal and state taxes, $21,633; depreciation at federal rates, $29,192; insurance, $751; administration, $9,009, and return on plant investment, $41,380.

Industry Will Foster Post-Graduate Education

By E. B. ROBERTS*
Technical Employment Division,
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

One cannot contemplate the plight of 10,000 so far unemployed engineering graduates of 1933 piled upon the 10,000 of 1932 and many more of earlier years without meditating over new objectives in the field of engineering education for the years ahead. The inescapable conclusions seem to be these:

1. We have passed from a period of exploitation, speculation and development into a level period of operating functioning in which fewer engineers will be needed.

2. Superior ability and training will be demanded for success both in the field of engineering operations (which will require the services of the greater number) and in the relatively smaller research and design group.

3. Quick adaptability to productive work will be rewarded. Five years of drifting and adaptation can no longer be tolerated. The big stake must come before 40.

4. Post-graduate training will flourish, in industry and as part of the job and with the schools co-operating. This graduate education will not all be vocational or professional. It will exhibit aspects of culture, seeking to develop independence of personality and creative thought.

5. Engineers will recognize new fields for their efforts. The occupational shift to commerce and distribution will continue. Engineers will come to believe that ability to perceive a new application for an engineering product and the negotiation of its use is as much an engineering function as the design and manufacture. Functions of negotiation, arbitration and interpretation will match the fields of research, design and processing as areas of endeavor for future engineers.

In substantiation of these inferences may be cited certain ominous indications in "Recent Social Trends in the United States."† Population growth rate is decreasing. The age characteristic is changing profoundly. In 1850 youth was abundant and age was scarce. This is now reversed. Youth as an element of population has been halved and in another twenty years it will be halved again. Youth scarcity will command a premium.

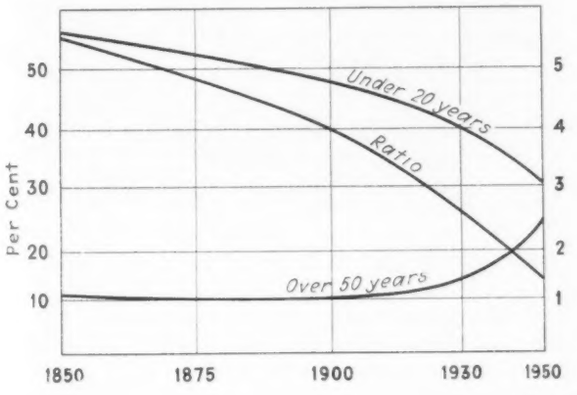
Engineering was the mainspring of the tremendous increase in industrial activity during the 1920-30 decade. Since then the shrinkage in international capacity to absorb the product of continued expansion has caused many engineers to settle into the operations of the machines they created, presumably for others to run. Some, more versatile, apply themselves to seek new outlets for their products. Many, however, can only tighten their belts and hope for the reappearance of demand.

It is the versatile group whose process of adaptation in the immediate future will bear most profitable observation. What they evolve for their own salvation will afford a superior guide to the trend of educational preparation of those who follow.

In business today not more than half of the better positions are held by college graduates. In the future the country will recruit a larger proportion of its leaders out of the ranks of those who have had extended formal education. This is so because there is not now in the ranks the relative number of young men of inherent ability that there was a generation ago. Those who have such innate abilities have found a way to go to school and they make up a large proportion of the increase in high school and college enrollment.

Abstract of an address before recent meeting of Land Grant College Association at Chicago, Ill.

†*Two volumes, McGraw-Hill, 1933.*



Population	Total	Under 20	Over 50	Ratio: under 20 to over 50
1850	23,500,000	13,000,000	2,350,000	5.5
1930	120,000,000	49,800,000	21,000,000	2.5
1950	140,000,000	42,000,000	35,000,000	1.2

In 1850 youth was abundant, maturity scarce; 1950 will see this reversed

Progress of Sodium-Vapor Lamps

Much progress has been made in perfecting sodium-vapor lamps, but there is a tendency in news reports and among enthusiasts to exaggerate the possibilities and get ahead of actual production or overlook matters of economy, according to Samuel G. Hibben, director of lighting Westinghouse Lamp Company. Sodium lamps so far developed, he maintains, are not expected to replace "Mazda" filament lamps nor become acceptable in residential or similar lighting service. Rather they must be considered as supplementary to present illuminants. Much work and study must still be done before this light source, despite its great promise, can be considered practical for general sales and service.

Sodium lamps have some interesting and peculiar characteristics. Monochromatic light of a golden-yellow hue is produced at an efficiency about twice that of hot-wire metallic filament lamps. The human eye is much more sensitive to this light than to the mixed colors of sunlight. For the same intensity we can in general see much better under sodium lighting, Mr. Hibben declares, and this is particularly important on streets and highways, where intensities at best are very low. At least three sizes are now being perfected, he reports, which may operate on ordinary a.c. lighting circuits, but each lamp requires a separate transformer to limit current and voltage.

These new lamps appear to have the additional advantage of reducing glare, because the source of light becomes a relatively large bulb completely filled with the glowing gas. While this property makes it necessary to design new reflectors and accessories and forego some of the exact control of rays, still the sodium light does

have offsetting advantages for outdoor usage. It is not unlikely that next year will see many tennis courts, athletic fields, outdoor work places and the like bathed in the golden flood of sodium illumination.

At present trials of sodium lamps are being confined chiefly to highway lighting. In this service the color is of least consequence, but the higher visual acuity and reduction of glare are of utmost importance.

Reasonableness of Rates Demands Analysis

Because petitioners for a rate reduction for electric customers of the North Adams Gas Light Company compared the existing prices of the company with those of the Northampton (Mass.) Electric Lighting Company, under the same management (New England Power Engineering & Service Corporation), in seeking a cut, Edward C. Mason, for the North Adams company, discussed this procedure critically before the Massachusetts Department of Public Utilities.

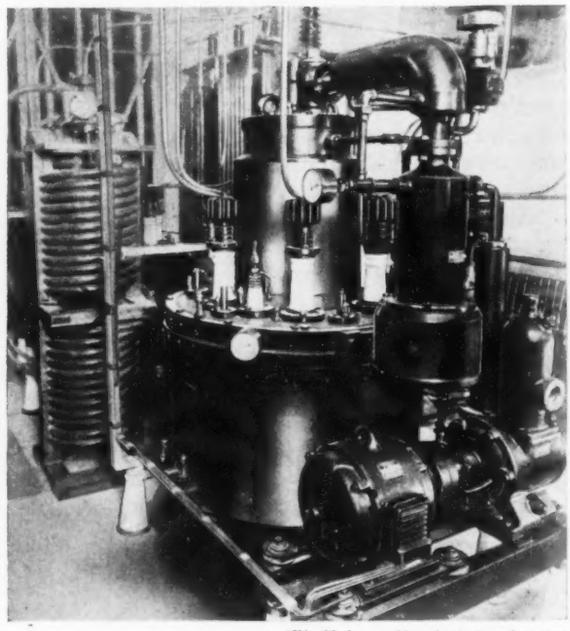
Mr. Mason pointed out that it is common knowledge that because of conditions peculiar to the Northampton company its rates are among the lowest in the state and compare favorably with those in such cities as Worcester, Cambridge and Springfield. "The only safe way to determine reasonable rates for any given territory," said Mr. Mason, "is to examine the local conditions. The cost of labor, taxes and of transportation are seldom similar in any two communities. Municipal requirements differ. Even the character of the soil and the lay of the land are frequently so different as to make comparison of rates misleading. Company methods of operation differ. One company may plow back into plant surplus earnings which otherwise might have been paid in dividends. Another company may reverse the practice. Each plan has its devoted adherents, but the question as to what a reasonable return upon the plant and property of any one company should be is vitally affected by the company's treatment of surplus earnings.

"Again, it should be noted in comparing rates in various communities, numerous factors, such as average use of electricity, the purchasing power of the population and the character of the business in a community, make any conclusion as to the proper rates for an electric company in one city a wholly unreliable basis for comparison of rates in another. As an example of the varying usage in the two communities in question, we find that the average annual consumption per customer in Northampton is about 500 kw.-hr., compared with only 375 kw.-hr. in North Adams.

"In the present case the petitioners have made no attempt to analyze the differences in conditions under which electricity is acquired and sold in Northampton and North Adams, . . . the present financial position of the company and its future prospects are the really important facts in the case. . . . In addition to increase in taxes and labor costs there have been since April 1, 1933, marked increases in the prices which the operating companies are compelled to pay for standard materials which are in regular use and which are bought at the lowest possible prices through the purchasing department of the New England Power Engineering & Service Corporation. Thus, overhead service cable has increased 30 per cent, weatherproof copper wire 50 per cent, bare copper wire 44 per cent, creosoted pine poles 21 per cent, crossarms 48 per cent, pole line hardware 12 per cent, distribution insulators 26 per cent, distribution transformers 11 per cent and electric meters 11 per cent, while some supplies, such as splicing sleeves, underground connectors and fiber conduit, have increased from 50 to 89 per cent."

In conclusion, referring to North Adams, Mr. Mason said that an electric company whose rate of earnings on its property which is used or useful in the public service has fallen from 10.6 per cent in 1931 to 7.4 per cent in 1933, with a prospect of further drastic reduction in earnings, should not be called upon further to cut its income by reduction in rates "until a clearer view can be had of the financial and other burdens which the company must shoulder and of the effect which its additional tax and employment problems, combined with its increasing costs of materials and supplies, due to new industrial conditions and general inflation, will have upon the company under the rapidly changing industrial and political conditions of the present time."

Mercury-Arc Rectifiers for Radio Broadcasting



Allis-Chalmers Manufacturing Company

An important part of a high-power radio transmitter is the supply of high-voltage d.c. power for the plate circuits of the transmitting tubes. In station XER at Villa Acuna, Mexico, a steel-inclosed mercury-arc rectifier is used for this purpose. It is rated at 800 kw., 18,000 volts d.c. and provision is made for sufficient capacity to supply power to a 500,000-watt station. The output voltage is controlled by grids, and a smooth regulation from zero to 18,000 volts is obtained with the usual simple grid control equipment. The control grids are also used for automatically interrupting short circuits and backfires, without interrupting the service of the transmitter.

NRA and the Small Utility

By A. W. CONOVER
Vice-President Oklahoma Utilities Company, Bristow

Contrary to public belief, the electric utility industry is not an assemblage of giants only. There are many small systems whose functioning will be made extremely difficult if the electric utility code now under discussion does not recognize their peculiar problems. More than the larger companies, the small utilities are affected by federal encouragement and aid to municipal competition.

Mr. Conover discusses these matters and also deplores the (to him) apparent inactivity of industry leaders in defense of the light and power business. This article is, in substance, a presentation of a talk made by Mr. Conover at the code conference called in St. Louis by the Edison Electric Institute.

EVERY industry code so far approved by the administration grants the right to live to the units it controls. Apparently the electric utilities are to be denied this protection. Because of this and since wages in our industry are higher than the average of others, most certainly we should oppose drastic reductions of working hours as applying to small systems because we have no means of offsetting this added expense, and our operating results in recent months indicate that the cost of compliance with recovery measures is already a very heavy expense burden on smaller utilities. We have made numerous inquiries in several small communities throughout our state and we find that practically every merchant is working his employees on a 48-hour week basis. Certainly we should be granted a similar concession when the previously mentioned conditions are taken into consideration.

In some instances it will be practically impossible to change present methods of operation to comply with the letter of a general code. For example, where a utility furnishes a house and all utility service to an operator of a substation located in a small community the problem is most difficult. The expense of four six-hour operating shifts is obviously more than the traffic will bear in practically every case of this kind. Such conditions as this will have to be given consideration, otherwise it will be necessary for us to push the installation of automatic equipment, which certainly will not assist but will retard re-employment.

Increased competition and no higher income

All other industry codes provide for restoration of price levels. Utilities have consistently reduced rates, especially during the depression. It will probably be impossible to get the administration to consent to the requirement of certificate of convenience and necessity for municipal undertakings, but in lieu thereof the utilities should at least get commitment from the administration discontinuing the policy of loaning P.W.A. funds for construction of duplicate facilities and thus encouraging competition where facilities are adequate and ample and rates reasonable. Also, relief should be afforded from demands for further reduction in rates where existing revenues and earnings do not justify such reductions. All of us are conversant with the argument supporting this contention. Most pertinent, in my opinion, is the fact that continued persecution defeats the fundamental purpose of the recovery administration and the strangling of public utilities will further postpone recovery in the capital goods industries, without which no stabilized recovery can be achieved. Utilities expended an average of seven hundred and fifty millions of dollars a year during the preceding five years, and each fifteen hundred dollars provided one man with one year of work. Obviously utilities cannot resume capital expenditures even in a modified manner if earnings and credit are further impaired.

I believe that I express the opinion of every small utility operator when I say that we should advocate a strong militant and aggressive policy on the part of utilities and organized industry to combat present anti-utility sentiment which threatens crippling impairment, if not complete destruction, of our business. We smaller operators have become alarmed at the do-nothing attitude of our leaders in the Institute, and we vigorously oppose continuation of this policy of aloof silence which is contrary not only to the sentiment of a numerical majority of utility operators but also to the editorials of trade papers and impartial financial publications.

Advocates presenting problems to government

In a recent issue of the United States *News* David Lawrence outlines the present situation confronting the federal administration. It is interesting to note that throughout his editorial he infers that the government should treat us with frankness and should take us into its confidence; in other words, should lay its cards on the table so that we may all know what the administration has in mind. This is good advice to the government and it is good advice to us also. It is lamentable, but true in so far as I can determine, that as an industry we have not taken our problems up with the government. As I see it, we have nothing to hide from the administration. It is true that we have made mistakes, but where is the industry in which similar faults cannot be found?

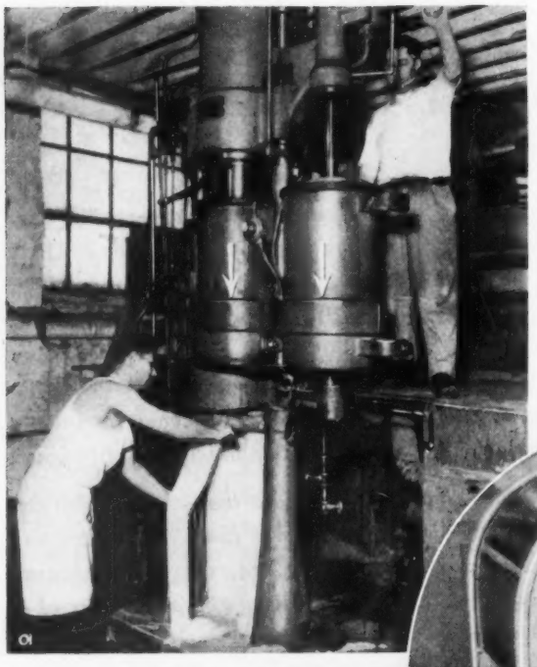
I urge that as an industry we should initiate a strong offensive against increasing tax burdens, against the unfairness of exempting municipal operations from the federal excise tax and against the use of R.F.C. and other public money to finance competitive operations which destroy any chance for the utilities to aid in the recovery program. Also, sentiment should be built up against the sacrifice of legitimate operating companies in an attempt to punish holding companies.

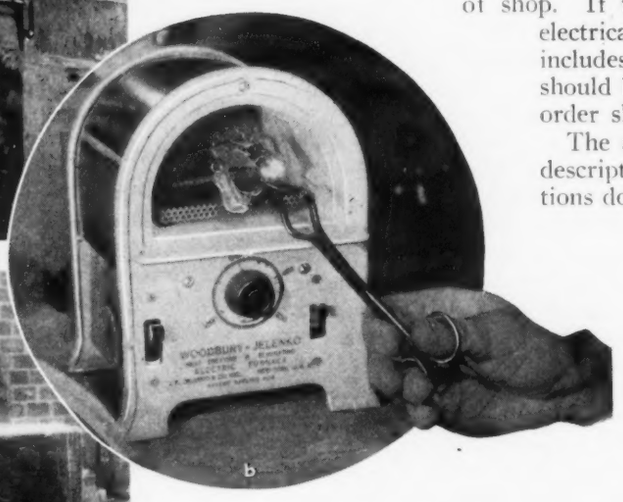
Small Heating Units

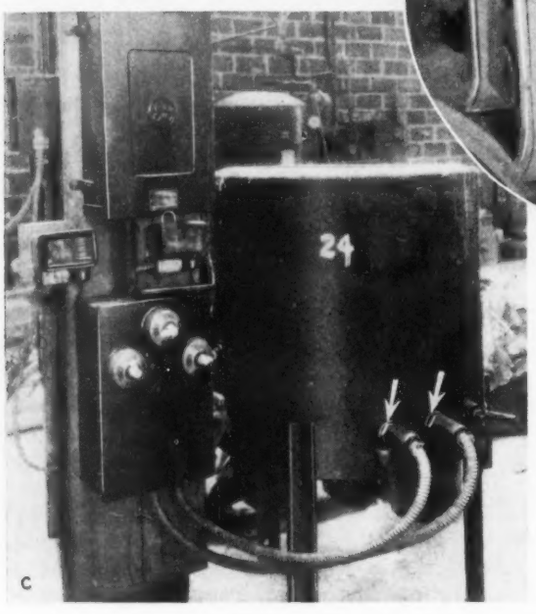
SMALL units of electric heat are limited in industrial applications only by the perseverance and ingenuity employed in finding places to utilize them. So long as gas, oil, coal, wood, candles, matches or cigarette lighters are used to heat things up in factories and shops, so long also does the field for the versatile electric unit remain unsaturated. Probably as good a way as can be devised for finding prospective uses for these units is to trace to its source every wave of warmth that fans the cheek as one walks through any kind of shop. If that source of heat is not electrical then the economics which includes convenience of operation should be studied to see if the old order should be continued.

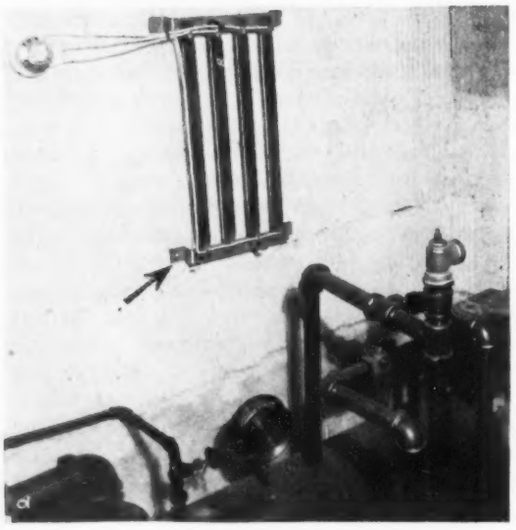
The accompanying pictures and descriptions of small heat applications do not cover the field; on the contrary, they are only feebly indicative of their extent and diversity. From macaroni to dental plates and on all processes and products in between and beyond, the electrical B.t.u. is always clean, controllable and safe.

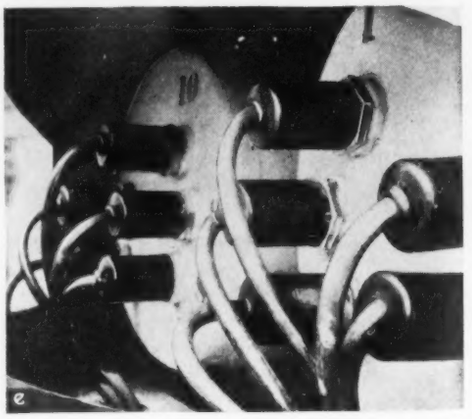
(See also page 82)











(a) **No more steam-heated macaroni**—The Viviano Grocery & Manufacturing Company formerly used steam to heat the dough during the extrusion process. On cold mornings time was lost in starting the presses because the steam supply was somewhat limited and more of it than usual was needed for building heating. And from other points of view steam was unsatisfactory. So, four 500-watt strip heaters were bent around each of the two cylinders of Viviano's macaroni press—4 kw. of electric heat—and now the production of macaroni (maybe it's spaghetti or vermicelli) is never held up on account of cold dough.—*Watlow Electric Manufacturing Co.*

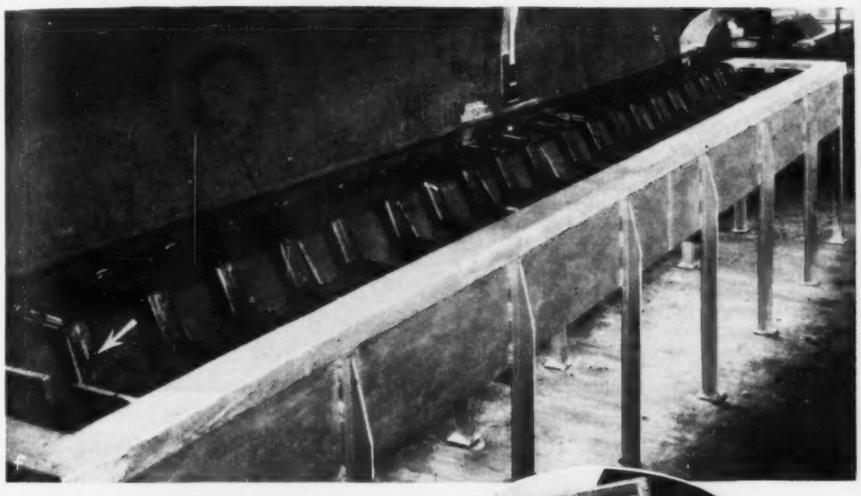
(b) **Heat treating gold**—It is reported that by properly heating and cooling gold various degrees of hardness can be obtained. This is important in the manufacture of dental work, as we put considerable pressure on dental parts when eating, which sometimes causes the general shape of the inlay or bridge to change. The Jelenko company has perfected a cycle of heating and cooling specifications for which this particular furnace was designed. A similar furnace rated at 600 watts, 110 volts, and providing a temperature up to 1,960 deg. F. is used to bake glaze on false teeth which will match in color the natural teeth.—*Westinghouse and J. F. Jelenko & Co., Inc.*

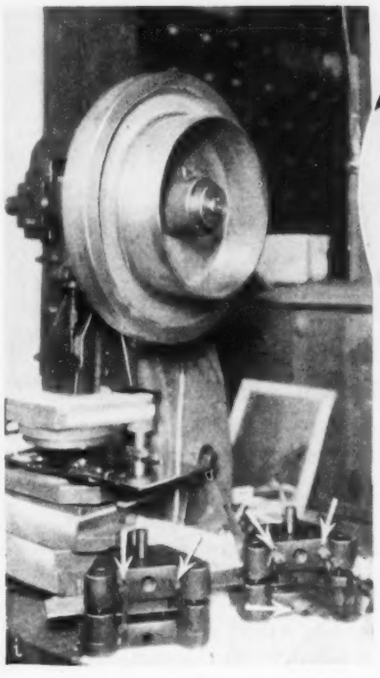
(c) **Not too hot, not too cold**—Three liquid-heating units inserted in the bottom of this pot plus some inexpensive automatic control to regulate the temperature provided a fiber-can manufacturer with a paraffin-melting pot.—*General Electric.*

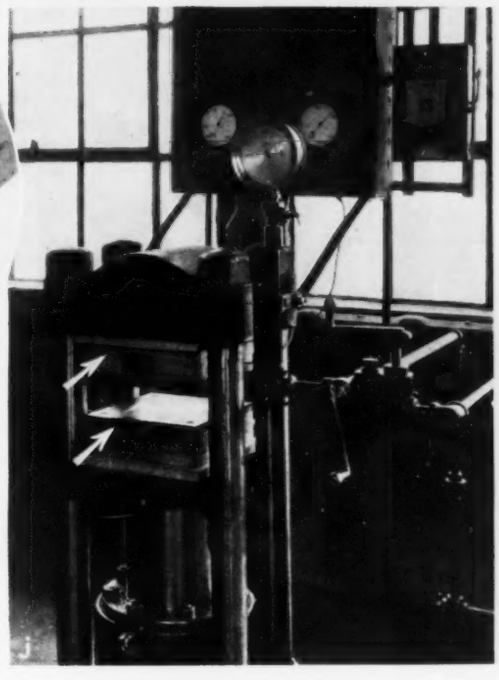
(d) **For fire protection**—Four 500-watt space heaters are used in a valve house and pump room to prevent the pipes freezing. This particular installation is in a house controlling the sprinkler system in an industrial plant.—*Westinghouse.*

(e) **Warm oil for airplanes**—A large oil company has trucks to rush oil to airports—the oil must be at airplane-engine temperature, so eight liquid-heating units are screwed into the oil tanks of the airport tenders. Automatic control maintains the temperature.—***General Electric.***

Find Increasing Application







(f) **Tinning tank**—A few pieces of standard steel shapes and twenty metal-melting units provided an inexpensive, home-made tinning pot of huge capacity.—*General Electric.*

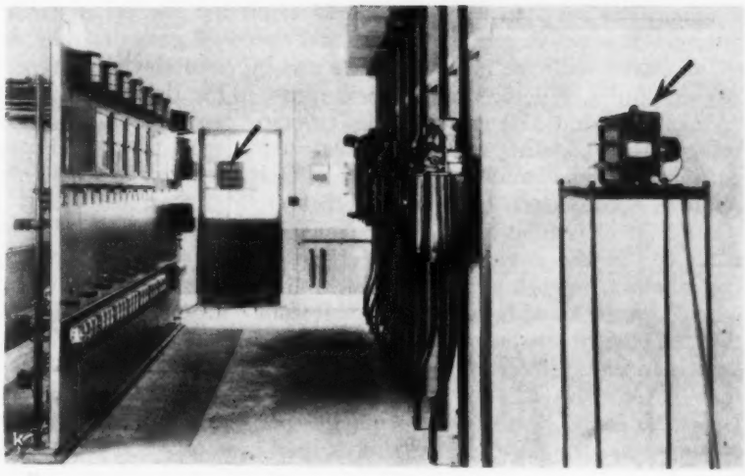
(g) **Brush-making needs hot cement**—A leading brush manufacturing company has equipped all its plants with cement-melting pots heated by a bottom hotplate in which are imbedded six (200-watt) cartridge units.—*General Electric.*

(h) **"Name on your fountain pen, mister?"**—The "namograph" machine manufactured for and distributed by the Sheaffer Pen Company. A heating element and thermostat maintain the dies at the correct temperature for printing names on fountain pens.—*Westinghouse.*

(i) **Dies must be hot**—A punch press used on a particular application required heated dies. There are two extra dies on the table at the right of the press with the cartridge heaters inserted in them.—*Westinghouse.*

(j) **For working synthetic plastics**—Bakelite platen press fitted with electrically heated platens. Economy, convenience, low maintenance costs. Higher temperatures than can be reached with low pressure steam.—*Harold E. Trent Co.*

(k) **Keeping substation comfortable**—Portable space heaters (see the second one in the background against the door window) keep this substation of the Bendix Aviation Corporation plant comfortable for the operator.—*American Foundry Equipment Co.*

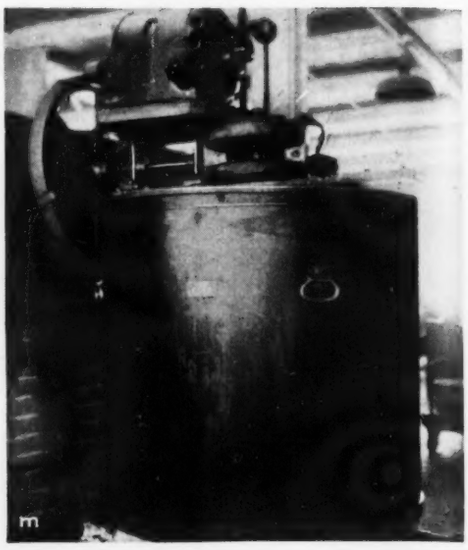


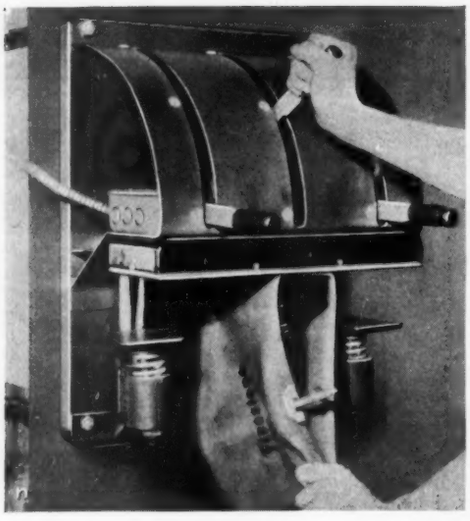
(l) **Sealing cellophane sacks**—The machine is heated by a small cartridge type element, thermostatically controlled to average about 125 watts in continuous operation.—*Harold E. Trent Co. and Heat Seal-It Co.*

(m) **Paper-pulp producers** — Papier-mache is cooked and agitated in this electrically heated 75-gal. kettle with automatic temperature control (from 90 to 200 deg. F.) connected load 10 kw., 220 volts, using strip heaters on a frame. Advantages—convenience, economy and temperature control.—*Harold E. Trent Co.*

(n) **Punctures repaired promptly**—Electrically heated tire-vulcanizing equipment. A thermostat controls the temperature at the correct value for vulcanizing and avoids burning the rubber.—*Westinghouse.*

(o) **Nothing electrical here?**—But look at the two square cases above the steam pipes along the left wall. They contain instantaneous heaters to supply hot water for the wash troughs.—*Electric Heater Corporation.*





Electric Hotbeds Aid Market Gardeners

An increased demand for electric hotbeds in New England has resulted in recent weeks from the success attained in improving plant quality and speed of growth as compared with the use of manure and other methods. About 8 miles of hotbed cable is now in use in the Boston district by some 120 growers, the principal application being for propagating early vegetables and rooting plant cuttings, shrubs and evergreens. Each hot frame requires about 60 ft. of cable at 115 volts and thermostatic control is used after sunset, manual control being employed in the daytime. Around Boston the cable is laid about 6 in. below the surface, and at times a bed of cinders is placed below the soil. Recent data indicate that the energy consumption is about 1 kw.-hr. per square yard per day. The cost of installation in the Boston district averages $13 for two 6-ft. x 6-ft. sashes. It has been found that seeds germinate, plants grow and cuttings take root in from 20 to 30 per cent less time than under ordinary methods. In bench propagation it has been found that the number of cuttings rooted has been increased from 10 to 50 per cent by electric heating.

With this method time is saved each spring in getting hotbeds ready for service and annual rebuilding is eliminated. The top soil is changed as desired or the cable taken up and placed in new beds. Later it can be used for fall plantings, when maximum heat is required. In a Rhode Island experimental tree nursery a full year, or one transplanting, was saved by electric heating on yew and evergreen. On the Cherry Meadow Farm in South Framingham, Mass., 48 sashes used last winter will be doubled this year. In other cases lettuce and cabbage gained two days over normal time and tomatoes gained four days. Peppers and egg plant in another bed showed a healthy growth in twelve days and were ready in twenty days for transplanting, while other seeds in unheated frames were only just beginning to break through the surface. A market gardener near Lowell, Mass., installed 78 hot cable sashes last spring and was able to market the produce eight days earlier than usual. This equipment will be doubled this winter to start squash, cucumbers and cabbage.

Control Methods Applied to Utility Stock

By PAUL S. HAMILTON
Assistant General Storekeeper Detroit Edison Company

IT HAS long been recognized in merchandising and manufacturing operations that working capital tied up in goods must be kept at a minimum if the business is to be successful. "Quick turnover" is the aim. Just as other businesses appreciate that profit lies in the shortest time and the least money between the "out-end" of sales and the "in-end" of manufacturing or buying, so also should it be apparent to the electric utility that stocks of materials and supplies must not remain too long in warehouses nor too much money be invested in them. How stock control can be effectively applied is shown by the simple method in use in the Detroit Edison Company, which was as successful during the late lamented years of heavy construction as it is now proving itself to be during these trying days of recovery.

The Material and Supplies Account is divided up into six parts or classes:

1. *General Stock*—This consists of the most generally used items in a public utility. Such items should usually be purchased in sufficient volume to give the purchasing agent good bargaining power. Any sub-class of this material is coded since its use is irregular and items are usually held in a certain warehouse for specific departmental use. By coding, a department is assured this material will not pass out into general use without its consent being obtained.

2. *Special Maintenance Stock*—Not clearly definable. It is a cross between the much-used general stock and the little-used spare parts.

3. *Spare Parts Stock*—A very general idea of this class is gained by saying that theoretically its turnover should be zero. It might be called insurance for continuity of service. The study of spare parts stock is generally neglected by utilities. In the Detroit Edison Company a mechanical engineer was used in the study with most gratifying results.

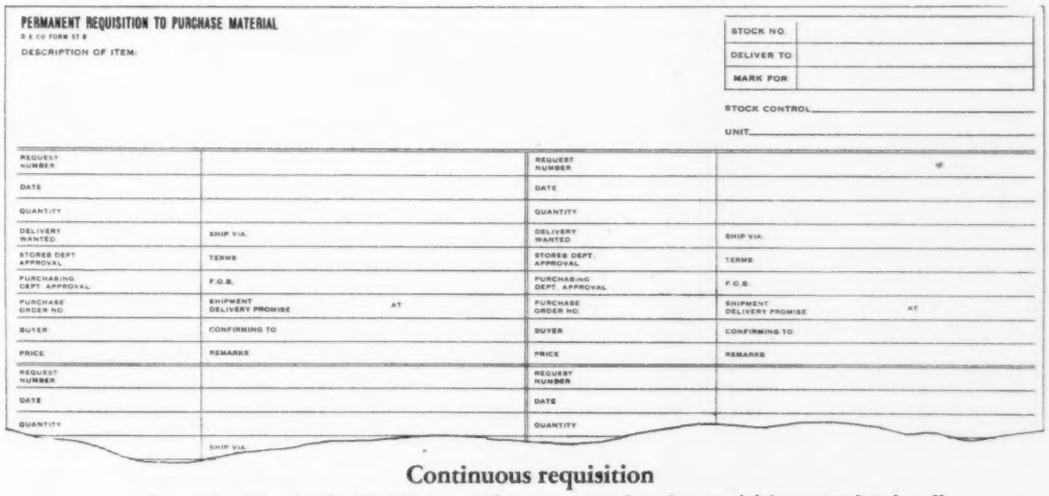
4. *Experimental Stock*—This is purchased only on request and purchase is never repeated unless specifically ordered. The reason is plain. If repeated requests are made, it is no longer an experiment.

5. *Special Construction Stock*—There are some objections to this classification, but I give what are the most valid reasons for its being. Large transformers, regulators, etc., are frequently bought in advance of formal executive approval through the stock account, because they require so long a time to manufacture. Another reason, where a large number of substations exist, it becomes necessary to keep spare major equipment on hand to take care of burn-outs. Since this is so, the care and storing is best in the hands of the stores department. When needed, these pieces of equipment can be ordered out and charged to the correct capital account.

6. *Surplus Stock*—Any large organization has odds and ends of some money magnitude left over in stock. When such items are too good to scrap and they do not belong in the other five classes, they are moved to surplus and advertised throughout the company in special lists. Draftsmen and designers check such lists before even completing a design and check again at the time the bill of material is made out.

All requests for new stock items are made in writing and by a responsible department head or assistant. The stores department usually promptly orders them—specifying only that if they are not used, or if the usage is small, the right is reserved to transfer them to surplus. Also, the right is reserved to cut down the amount requested unless good and sufficient reasons are advanced in favor of the larger amount. These letters, or requests for stock, are kept in what is known as a history file. Here, filed by stock number, they are readily accessible and provide potent ammunition for the stores department in curtailing unneeded items. There is a committee that effectively weeds out slow-moving items and keeps the stores account free and clear from that dread character "dead stock." To each item that comes into stock is given a code based on a classification system and on the fact that in this utility mechanical accounting is used. After being classified and numbered, a requisition is prepared to go to the purchasing agent.

A permanent or continuous requisition card has been of great help to both the stores and purchasing departments. It contains room on both sides for twelve transactions, thus providing buyer and stock control man with a valuable past history of vendor, price and item. The inventor of this valuable system is, so far as I know, W. F. Stevens, general storekeeper of the Edison Electric Illuminating Company of Boston. Our company has, however, modified, and we believe improved on,


PERMANENT REQUISITION TO PURCHASE MATERIAL

D. E. CO. FORM ST. 8

DESCRIPTION OF ITEM:

STOCK NO.
DELIVER TO
MARK FOR
STOCK CONTROL
UNIT

REQUEST NUMBER		REQUEST NUMBER	
DATE		DATE	
QUANTITY		QUANTITY	
DELIVERY WANTED	SHIP VIA	DELIVERY WANTED	SHIP VIA
STORES DEPT. APPROVAL	TERMS	STORES DEPT. APPROVAL	TERMS
PURCHASING DEPT. APPROVAL	F.O.B.	PURCHASING DEPT. APPROVAL	F.O.B.
PURCHASE ORDER NO.	SHIPMENT DELIVERY PROMISE AT	PURCHASE ORDER NO.	SHIPMENT DELIVERY PROMISE AT
BUYER	CONFIRMING TO	BUYER	CONFIRMING TO
PRICE	REMARKS	PRICE	REMARKS
REQUEST NUMBER		REQUEST NUMBER	
DATE		DATE	
QUANTITY		QUANTITY	
	SHIP VIA		

Continuous requisition

On each side of this 8½x10¾-in. card are spaces for six requisitions, twelve in all

Mr. Stevens' idea. The form used is shown in the accompanying illustration.

Items already in stock are reordered on these same cards from data supplied by questionnaires. These are prepared in the warehouses when stocks become low. The stock number, brief description, amount on hand, amount needed for definite jobs and data on the consumption help the main office to gage ordering quantities. In general, it is desirable to try for a turnover of four times a year. In practice, this does not work out due to slow-moving items, spare parts and the temptation to buy larger amounts to obtain quantity prices. Under these conditions, the company looks on two as a good turnover figure.

Accurate descriptions of stock items are very important, so much so that a master card catalog was set up and any drawing number, specification number or other changes are promptly recorded on it. Certain classes of material, for example, pipe, pipe fittings, etc., were assigned to one man. Another took all spare parts, mechanical and electrical. A third, all overhead lines material, etc. Each man not only was held responsible for his particular line but was encouraged to study and find out all he could of such material. Copies of all construction work orders were passed over his desk and he was given all possible advance information on contemplate projects.

Gradually the men were formed into such a team that month by month waste was eliminated, inventory reduced and, more important, "controlled."

To Extend Water Heating to Price-Scared Class

Even though many utilities have adjusted their rates to make the operating cost of electric water heating competitive with other means, the Hynes & Cox Electric Corporation, Albany, N. Y., believes that a large part of the public cannot be induced to adopt this form of heating unless it is made relatively inexpensive to convert from existing equipment. Competition has been increased particularly in rural areas by the inroads of bottled gas and kerosene water heaters, it is reported. To develop quickly the acceptance of the vast majority of people who cannot be induced to invest the money needed for a complete factory-built assembly, this company considers that conversion equipment is the answer. As experience with the satisfaction of electric water heating becomes more extensive it may be expected that the investment in a completely new installation will become less of a deterrent to further adoption, although there will always exist the class which feels it cannot afford more than a conversion job. The problem is much like it was in the automobile field—to sell a large number of people facilities at a price they feel they can afford and then convert them to the value of equipment with further refinements. Conversion equipment also fits into the rental picture because it cuts down the first cost.

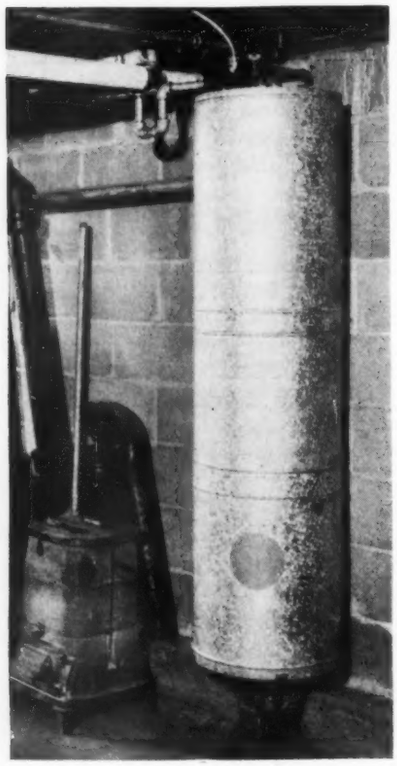


Fig. 1—Range boiler converted to electric heat

A conversion-installation embodying a strap-on heater element and thermostat assembled on a standard range boiler with heat insulation and a metal casing is illustrated. According to the Hynes & Cox company, the material to equip a 30-gal. tank with a 1,000-watt element, thermostat, heat fuse, insulation and metal casing costs $13.95. The additional cost of increasing the rating to 2,000 watts by putting on a 1,000-watt top element controlled by a top thermostat and heat fuse is $8.33. Based on installations already made, the cost of installing, including BX wire, fuse box and labor, has been less than $10, the company reports. This makes a complete electric water heater installed in the home for less than $25.

A number of test installations have been made*, some with double units, some with a single. In one installation, involving a family of five adults and two children using a 30-gal. tank with a 1,000-watt element at the top and bottom, tests were conducted eight days. A total of

**See article by George M. Palo, Puget Sound Power & Light Company,* ELECTRICAL WORLD, *October 7, 1933, on tests of similar clamp-on equipment.*

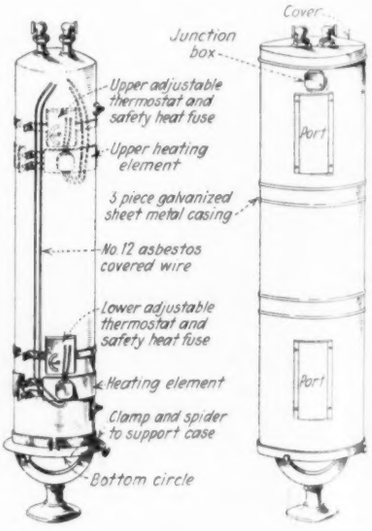


Fig. 2—Assembly of parts for converted heater

The strap-on heating element developed and used extensively by the Ontario Hydro-Electric Power Commission for the past year is of the low-density type and less than ¼ in. thick, allowing space for heat insulation between it and case. The thermostats are adjustable and can accommodate a heat fuse that cuts off power if water becomes dangerously hot. Rockwool is used for insulation. Portholes in case allow access to thermostats and terminals.

448 gal. of water was used with a consumption of 112 kw.-hr. With the top element removed a record of nine days' experience showed 552 gal. of water was drawn with a consumption of 111 kw.-hr. The Hynes & Cox company reports that entirely satisfactory hot-water service was rendered this family with just the lower element.

In another installation, involving a family of four adults and two children, a 30-gal. tank with a 1,000-watt element is reported to be giving entirely satisfactory service. For a test period of sixteen days 645 gal. of water was drawn with a consumption of 155 kw.-hr.

Revised Layout Improves Condition in Woolen Mill

By FRANCIS A. WESTBROOK
Center Conway, N. H.

The Kezar Falls Woolen Company, Kezar Falls, Me., has just completed the installation of a new Hunter wetting-out tank and carbonizer by means of which a source of serious inefficiency has been removed.

Formerly this particular process was carried on in one part of the plant, with old machinery, and the goods were then transported to the other end of a large building to a new Hunter drier and baker. This condition lasted for about a year. The difficulties of operating in this manner were largely due to the need of synchronizing two widely separated operations so that the wet goods would be delivered to the drier before they had a chance to dry around the edges and cause imperfect material. It was not always possible to synchronize accurately enough to avoid this source of trouble, and wastes occurred which could have been avoided with improved arrangements. In addition to this a man was needed for the wetting-out and carbonizing machine and another to attend the drier and baker. Transportation of the wet materials was also something of a problem because of the need of doing it at just the right time.

In order to overcome these inefficiencies the new wetting-out and carbonizing machine was installed in line with the drier and baker, both being driven by a single motor through adjustable speed transmission. Thus the material goes from one process directly to the other without delay and without rehandling, services of an operator are saved and spoilage is reduced to a minimum.

The layout of the electrical control equipment and the wiring was entirely revamped when the new machine was associated with the existing drier and baker. Push-button control was provided for throughout. Three such stations were necessary for the control of the circulating fans of the drier and one for the main drive. The acid pump and water pump are operated from separate reduced voltage compensators. It was, of course, necessary to locate all of these conveniently for the operator and also in a place where there was room enough to do it neatly and safely. How this was done on the partition wall at the head of the wetting-out and carbonizing machine is shown in the accompanying illustrations.

Wires for the pumps are in conduit and those for the fans and drive in BX cable. All the starting apparatus is fully inclosed in metal boxes and the equipment is all standard. The diagram shows the scheme of wiring.

The remote-control starters have their separate push-button stations, located on the wall back of the machine, and each motor has its own control switch and overload release with the exception of the two lower circulating fans on the baker, which have the same starter but separate overload releases. The starter for each pump motor is on the wall near its pump and includes overload and under-voltage releases.

From this it will be seen that each motor is fully protected by disconnect switches, that very convenient individual control is provided for each and that there is a minimum of wiring and conduit work. Furthermore, all the electrical equipment is out in plain sight where it is easy to maintain it and where trouble may be readily detected.

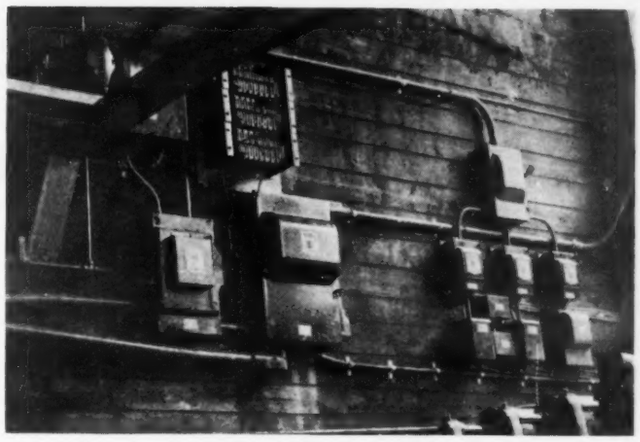


Fig. 1—Cut-out switches and remote-control starters mounted near wetting-out and carbonizing machine

Main drive is shown in upper left corner. The grid in upper center is left over from old arrangement and no longer used.

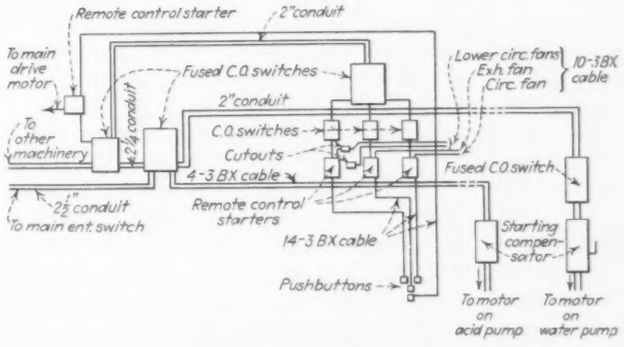


Fig. 2—Connections of electrical accessories used with revised layout

Main feeder circuit entering at the left terminates in a fused cutout switch. One branch goes from this through an individual fused cutout switch for the water pump motor to the starting compensator operating the motor. A second branch feeds the acid pump motor via a starting compensator. The third branch is connected to the feeder side and terminates in a second main fused cutout switch. One branch from this switch feeds the main drive motor through a remote-control starter. A second branch terminates in another fused cutout switch, from which each of the three remote-control starters operating the baker fans are fed via a separate cutout switch, not fused, for each starter. A third branch furnishes power to apparatus not concerned in this discussion.

Tests Demonstrate Steam Plant Standby Characteristics

By V. F. ESTCOURT
Pacific Gas & Electric Company, San Francisco

More than 45,000 kw. of load picked up in 50 seconds by high-pressure, compound turbo-generator unit operating at light load as system standby plant.

ON THE Pacific Coast that portion of the electric load carried by steam stations depends largely upon the amount of water storage available for hydro-electric generating stations. During periods of low water storage the steam-generating stations usually operate on a base load, whereas during periods when there is an abundant supply of water power the steam plants are required to operate for standby purposes only. In the latter case the steam plants operate at very low loads and must be ready to pick up large blocks of load in a few seconds in case of failure of any part of the hydro-electric system or transmission lines feeding metropolitan load centers.

The capacity for sudden pick-up of large blocks of load require uneconomical operating conditions of standby service. The turbine must be operating, and preferably be carrying enough load to allow full fires in sufficient boilers to accommodate full load. As many boilers as possible should be at or near line pressure, as the stored heat will assist materially in carrying considerable load for a short time with the unit operating at reduced steam pressure. The maximum output of the unit will vary almost directly with the steam pressure, and maximum load cannot be expected until full boiler pressure is restored.

When the 1,400-lb. station "A" of the Pacific Gas & Electric Company was first put into operation, early in 1931, the units were required to operate on a base load and continued to function in that way until early in 1932. Then, with plenty of hydro-electric water storage, it became necessary to operate the station as a standby plant and tests were conducted to discover the limitations of the equipment, if any, when operating in this manner. Pending the results of the experimental work contemplated, the turbines were restricted as to load pick-up by means of a load-limit device to permit only a limited travel of the governor pilot valve.

With a plant of entirely different design and operating pressure than anything previously installed on this coast, there were naturally a number of unknown factors directly related to the problem of picking up load suddenly. The most important of these were as follows:

(a) During a very sudden increase in load there was the possibility of the high-pressure generator becoming overloaded or pulling out of step with the low-pressure generator, due to the fact that the increase in steam flow to the unit affects the high-pressure turbine first and causes it to take most of the load increase until the pressure in the cross-over piping between high- and low-pressure turbines readjusts itself to the new load.

(b) A possible excess pressure differential across some of the diaphragms in the high-pressure turbine.

(c) A possible excessive reheat temperature.

(d) A possible excessive "swell" or increase in drum water level due to sudden increase in rate of steam liberation.

(e) Possible limitations in the time required to increase the fuel and air flow to the boiler in order to maintain steam pressure.

In order to determine whether any of the possible limitations mentioned would actually materialize during a sudden increase in load a series of load pick-up tests were conducted. The maximum capacity of each unit with full extraction is approximately 61,000 kw. and the initial tests were of the order of 10,000- or 15,000-kw. instantaneous load increase, culminating in the final test described below and consisting of a pick-up from 10,000 kw. to the maximum capacity of the unit. None of the possible limitations listed above were encountered in sufficient amount to be considered objectionable, and then only in the case of the full-load pick-up. In this case there was a momentary overloading of the high-pressure generator and the differential pressure between the third admission and ninth stage exceeded the maximum allowable working differential by approximately 2½ per cent. Both these conditions were of momentary duration and were not detected by observers during the test,

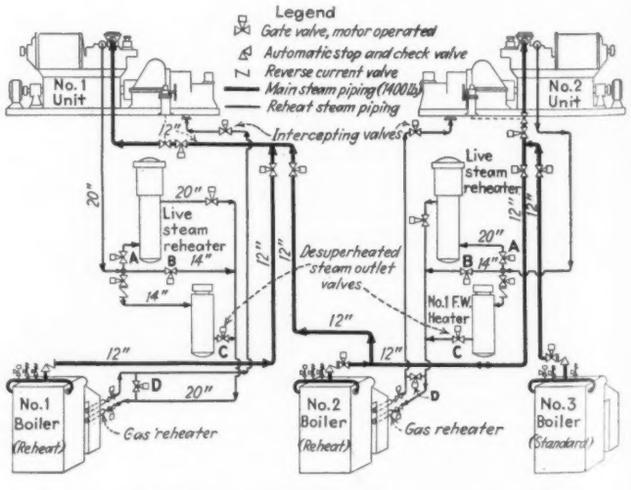


Fig. 1—Main and reheat steam piping at station "A"

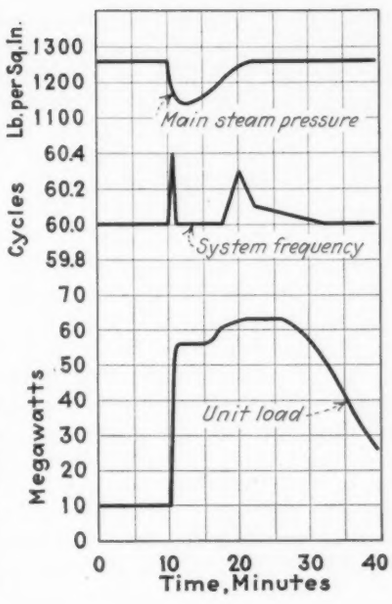
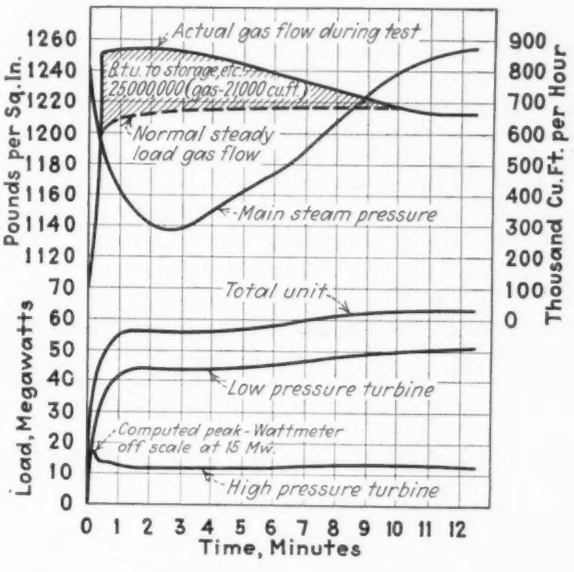


Fig. 2—Load, frequency and steam pressure during load pick-up test

Refers to 1,250-lb., 61,000-kw. compound turbo-generator unit.

Fig. 4—Fuel input and load distribution between high- and low-pressure turbines during load pick-up test

Refers to 1,250-lb., 61,000-kw. compound turbo-generator unit.



although visible in the motion pictures taken at the time of the test. There was absolutely no evidence of instability of the high-pressure generator in relation to the low-pressure generator. Reheat temperatures increased from 725 deg. to 775 deg. F. for a few minutes and returned to about 750 deg. F. This is entirely satisfactory.

It was found that the increase in drum water level was only slightly more than that which is characteristic of the setting of the three-element water-level control, which is adjusted to give approximately 3½ in. rise in water level from minimum to maximum boiler load.

The time required to increase the rate of fuel and air flow from minimum to maximum was about 24 seconds. This, however, was obtained by means of special high-speed control drives on the forced and induced draft fans and manual operation of the fuel valve. On the basis of the test, changes were made in order to make possible the accomplishment of the same result through semi- or full-automatic control of both fuel and air. There were no delays chargeable to lighting up burners due to the fact that, during some preliminary tests, it

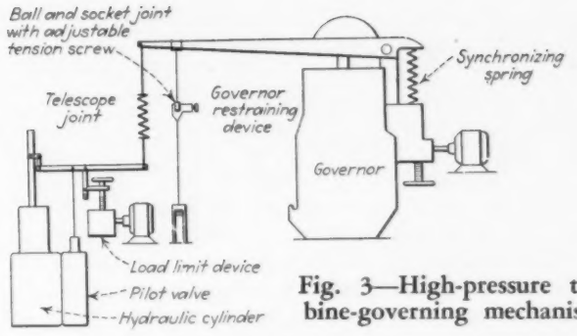


Fig. 3—High-pressure turbine-governing mechanism

had been found possible to operate at minimum load with the entire 26 gas burners in service, the gas pressure at this load being about 0.06 lb., increasing to 7.5 lb. at maximum load. The same flexibility is not possible with oil firing at the present time, but it is confidently believed that there are no inherent obstacles which would prevent the same performance with oil fuel. When the changes contemplated in connection with the gas-firing system are complete it is intended to put fuel oil firing on the same basis.

In order to maintain constant frequency during the test, arrangements were made in advance with the load dispatcher to have one or two of the hydro-electric plants stand in readiness to dump sufficient load to maintain the frequency as close to 60 cycles as possible, and in Fig. 2 it will be seen that there was not sufficient change in frequency to have any material effect on the test.

The restraining device shown in Fig. 3 was used to block the turbine governor at a steady load of 10,000 kw. The governor synchronizing spring was then run out to the full-load position, and at a prearranged signal the ball-and-socket connection was broken, permitting the governor to open the turbine control valves to their wide open position in three or four seconds. Referring again to Fig. 2, and also Fig. 4, it will be observed that the unit was carrying rated load in 36 seconds, and fourteen seconds later a load of 55,000 kw. was reached, which was the maximum capacity of the unit for the existing steam pressure.

At the time of the test both 61,000-kw. turbo-generator units were in operation and receivng steam from the one standard and two reheat boilers. The load pick-up was, however, handled by one reheat and one standard boiler, the load on the other reheat boiler and turbine being held constant, although the benefit of the steam storage capacity from all three boilers was obtained. This showed up very clearly on the boiler meter chart for the reheat boiler, which was being held at constant load, a momentary increase in steam flow being recorded therefrom without any change in the rate of fuel input. However, this steam flow dropped back very quickly to the original steady-load flow conditions. The maximum steam presure drop was approximately 8½ per cent, but as soon as the steam pressure started to recover no effort was made to hurry this recovery to normal as it was preferred not to "dynamite" the boilers any more than necessary. As the steam pressure was recovering, the load on the unit increased gradually to a maximum of 63,000 kw.

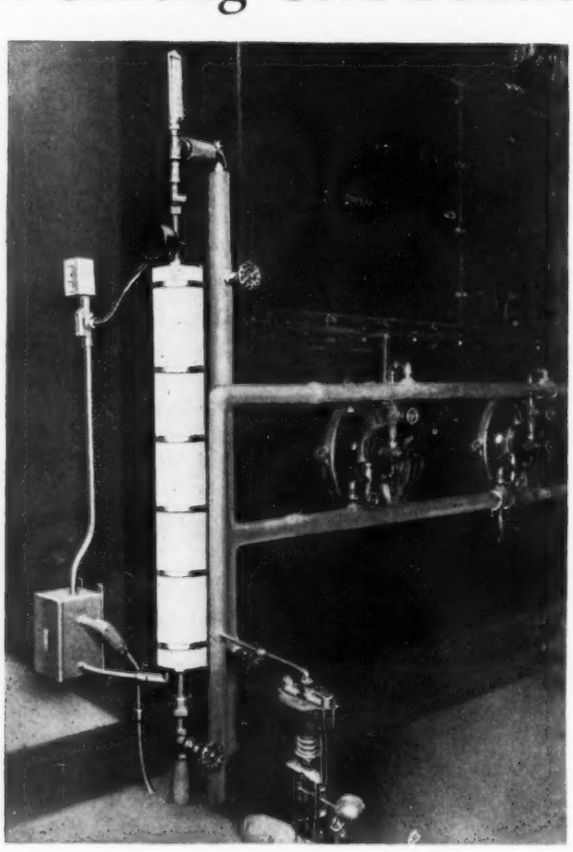
In Fig. 4 the actual rate of fuel input is shown as a solid line, and the broken line shows the rate of fuel input corresponding to the same loads under steady-load conditions. The shaded area, therefore, between these two lines represents the total additional fuel consumed

due to "over-fueling" the boiler during the load increase. The extra heat supplied in this way makes up for the heat released from storage due to the pressure drop, and part of it is absorbed in heating up the refractory in the furnace and part is required to meet the lower boiler efficiency during the sudden load increase.

The question might be asked why it required 60 seconds to reach the maximum capacity of the unit for the existing steam pressure, if the control valves of the turbine were opened wide in three or four seconds. First it should be realized that the conditions imposed by the test were not quite as favorable for a quick load pick-up as during a system disturbance, because during such disturbances a sudden drop in speed of appreciable magnitude usually occurs, and the energy liberated due to this deceleration results in an immediate increase in electrical output from the generator, depending upon the rate of deceleration. On the basis of a deceleration rate of one-half cycle per second, each of the station "A" units would deliver 5,500 kw. to the line due to drop in speed during a system disturbance. Time is also required for the steam pressure to build up in the turbine and piping. Furthermore, when the load first starts to increase, the capacity of the machine is limited on account of steam temperatures being below normal in the lower stages of the turbine due to the lower stage wheels being relatively cold. All of these factors undoubtedly contribute toward delaying the load pick-up during the first few seconds, but it would be interesting if more data could be obtained with which to analyze the factors inherent in the system which directly affect the time required for the turbine to pick up the load.

It is felt that this test has demonstrated the extreme flexibility of the 1,400-lb. plant. With centralized control one fireman per boiler can handle such load increments as have been described with a surprisingly small amount of effort. In plants where standby operation is essential during certain seasons of the year the ability to pick up the full capacity of the plant in a few seconds is an indispensable requirement. The favorable combination of operating flexibility and economy which can be obtained in the 1,400-lb. plant operating in the neighborhood of 750 deg. F. should therefore be given due weight in making studies of what might be realized by going to considerably higher temperatures as a substitute for the reheat cycle.

Electric Fuel-Oil Preheater for Starting Cold Boilers



In the Burroughs-Wellcome plant at Tuckahoe, N. Y., the boilers are idle over the week-end period. The fuel oil used in the Anthony oil burners is of low viscosity and is exposed to temperature conditions that require preheating in order to obtain satisfactory flow and atomization. A 6-kw. Ward Leonard electric heater is applied to the fuel supply line. It consists of a wire heating element wound over the fuel supply line and covered with asbestos lagging for insulation. Sufficient capacity is provided to secure quick heating. A thermostat is mounted in a casting fastened to the fuel line above the heater unit. Heat conducted through the casting operates the thermostat and limits the temperature of the oil by opening a contactor in the electric circuit supplying the heater unit. When the oil has been sufficiently preheated to insure atomization it is ignited at the burner and electrical preheating of the oil is maintained until steam pressure is produced. Then a steam heater is employed and the electric heater is disconnected. Steam preheated oil is then fed directly to the burner without passing through the electric heater.

LETTERS TO THE EDITOR

A Consumer Talks of Appliances

To the Editor of the ELECTRICAL WORLD:

It occurs to me that one of the principal obstructions to the sale of electrical appliances is the lack of information on the part of the consumers as to the cost of operating the devices per month. I have almost every known household electrical device and, being able to determine the load and usage of my various devices, I can predict quite accurately the added cost per month when I install a new unit of electrical equipment. My wife, however, pays the bill out of her allowance and is often busy turning out 40-watt lamps while forgetting to turn off a heating element on the electric range. It would seem to me the dealers in every kind of appliance in each town would help their sales if they translated the energy rating on each appliance into cents per hour for the large user and for the small user. Thus customers having electric ranges who receive the minimum rate for added load would become aware of the small cost per hour for fans, air conditioners, etc. If each appliance carried a tag stating briefly the average use of the appliance in a home and the cost in cents per month for the large user and small user of electricity the public would not worry about any marked increase in electric bills and would gradually add devices which in the aggregate would represent a sizable power market.

I am a customer of the Puget Sound Power & Light Company in Seattle and have almost a uniform electric bill the year around. The energy used in water heating during the summer is not used to any extent during the winter, when the load of the oil-burner motor plus the longer lighting period makes up the difference. I am installing a new G.E. air conditioner (humifilter) and expect the fan load to add 30 cents per month and the spray water heating load to add about 50 cents per month. There should be some reduction in operation of the oil-burner motor due to our reducing the room temperature under humid conditions, and this might offset these other items somewhat. However, this is conjecture and there is nothing on the tag attached to the humifilter which will help me to figure it out. I do, however, expect to save enough Diesel oil to pay the fixed charges and operating expenses on the air conditioner unit.

Pride plays a part in encouraging the extensive use of electric appliances in the home. If the local power company published the names of all customers who have completely electrified their homes there would be a rush on the part of the others to get on the list. I have just purchased a 300-watt semi-indirect stand lamp and my friends are enthusiastic about it. They will be good prospects for the humifilter after they see it in operation. Why not push these two devices and let refrigerators sell themselves. The public already wants the latter as soon as it has the money. Some people still have money to spend on worth-while electric devices, such as the high-wattage lamps and air-conditioner equipment, and they should be solicited in these post-depression days. The others will gradually get on their feet and come in to the cooking, water heating and refrigeration class without a lot of advertising and sales expense. In other words, the dealers and power companies should try to sell to those who have money. The others are already sold, but must wait a while before they can buy the older devices.

With only a limited knowledge of air-conditioning equipment, I am prepared to condemn every old steam and hot water heating plant which is not supplemented by humidifier equipment, and I will include a lot of air-washing plants which spray cold water on cold air and have no effect on the humidity of the air in rooms and offices. Only hot water absorbed by warm air will raise the humidity in a building. Another matter to consider is the reversal of common opinion that humidity is bad. We are brought up under the impression that humidity is not good for us because in hot weather the humid regions are almost unbearable. Also, we have been told that damp night air is bad for those having bronchial troubles. Both of these theories are good as far as they go, but the public must be taught that humidity in the warm rooms in the winter is very beneficial; under all other conditions it should be avoided. The electrical industry must do this job or it will not be done. There is no reason why the power people should not lead the way out of the depression instead of the automobile industry. People spend from three to ten or more times as many hours in their homes as they do in their automobiles and yet they will spend as much per month on their cars as they spend per year on comforts and conveniences in the home.

High school graduates should be taken through a completely equipped electrical home and a prize should be offered for the best essay on home design from a utility standpoint. They will not rest until their parents have seen the home and bought some pet appliance. With the price marked on each appliance and the average monthly cost of operation on the tag every one would be able to determine if he could afford the device. This is a long story, but it may have some value to the electrical industry.

3706-39th Avenue, South,
Seattle, Wash.

V. D. COUSINS.

Carbon Tetrachloride Good for Jewel Cleaning

To the Editor of the ELECTRICAL WORLD:

We read with considerable interest the letter written to you by Harold J. Cunningham, treasurer of the Industrial Jewel Company, Waltham, Mass., relative to the use of carbon tetrachloride for cleaning meter jewels. This letter was published on page 670 in the issue of the ELECTRICAL WORLD dated November 18, 1933. We have investigated this question thoroughly inasmuch as we supply meter jewels to a large number of central stations and we use carbon tetrachloride in cleaning our jewels. Our first information comes from the Bureau of Standards at Washington, D. C., from which we have the following report:

> Carbon tetrachloride has been used successfully in the cleaning of watch parts. There is, however, the possibility of decomposition of this type of solvent in the presence of light and moisture to form hydrochloric acid, which will corrode brass. The chemically pure (C.P.) grade should evaporate and leave no traces after evaporation. Any objectionable action due to deposits after evaporation would depend on what impurities there were.

The carbon tetrachloride we use is C.P. and is kept in opaque containers to keep out light and away from moisture.

We have also taken this question up with a chemist who advises us that *carbon tetrachloride and water will not mix*. What can occur is that heat will release free chlorine, which will combine with water to form hydrochloric acid, which will, of course, corrode brass. But, after cleaning, there is absolutely no carbon tetrachloride in the jewel to release free chlorine. We use this solvent under 125 lb. air pressure and the quantity of carbon tetrachloride that is in the jewel cup at any one time is infinitesimally small, and this small quantity evaporates immediately; in fact, the evaporation takes place during the time required to transport the jewels from the cleaning machine to our microscope, less than 1 ft. away. Inasmuch as we microscope-examine every jewel and the jewel must be thoroughly cleaned before it is possible to inspect same, we have tried out a number of cleaning fluids and have adopted carbon tetrachloride for its many qualities, i.e., quality of a solvent to dissolve oil, grease, etc., and because of its high volatility, which causes the fluid to evaporate so rapidly without leaving any trace, deposit or film on the object cleaned.

We trust that this information will be of interest to those who are using carbon tetrachloride for jewel cleaning and relieve their minds of any doubt as to the advisability of using this solvent.

Herman D. Steel Company,
Philadelphia.

P. N. STEEL,
General Manager.

THIS WEEK'S NEWS

T.V.A. Contracts With Utilities

COMPREHENSIVE and formal agreement between the Tennessee Valley Authority and Alabama Power, Tennessee Electric Power, Mississippi Power and Georgia Power companies, all subsidiaries of Commonwealth & Southern Corporation, was entered into last week. The contract, which will terminate as soon as power is available from Norris Dam, contains the following major provisions:

1. Purchase by the authority of approximately $3,000,000 of property from the Alabama Power Company., Mississippi Power Company and Tennessee Electric Power Company, by which the authority obtains immediate urban and rural markets in Mississippi, Tennessee and Alabama.

2. Sale of municipal systems in the Mississippi counties affected to the authority.

3. Sale of municipal systems in the Alabama counties affected to the municipalities by the Alabama Power Company.

4. Option is granted the authority to purchase municipal systems in the Tennessee counties affected.

5. An agreement to reduce electric rates by the Tennessee Electric Power Company to the level recently established by the Georgia Power Company.

In addition to these provisions, the contract stipulates further agreement as to power market areas, power interchange rates between the authority and the power companies and arrangements for the sale of electrical appliances through the Electric Home and Farm Authority, Inc., appliance subsidiary of the T.V.A.

Some contract features

Under the terms of the contract territories adjacent to Muscle Shoals and the Norris Dam at Cove Creek are taken over wholly or partially by T.V.A. purchase; the authority binds itself not to engage in competition with certain limitations; power interchange will be under a rate that starts at 3.6 mills for the first 300,000 kw.-hr. per quarter and reaches the low unit figure of 1.08 mills for excess over 43,000,000 kw.-hr. per quarter.

In Mississippi the authority will take over all transmission and distribution lines, substations, generating plants and other property (except one dam site) in nine counties in the northeastern corner of the state. The payment agreed upon is $850,000.

In Alabama seven counties (all of five and part of two) are involved and facilities will be gradually assumed there by T.V.A. for a final sum of $1,000,000 (slightly over 60 per cent of estimated reproduction prices).

In Tennessee all facilities in four counties and part of those in a fifth are to be gradually taken over for a settlement of $900,000 (about 66 per cent of the $1,365,353 replacement value set by the company).

All surplus hydro power of the T.V.A. is placed at the disposal of the power companies with 20,000 kw. guaranteed available at any time. The maximum that T.V.A. is entitled to demand at all points of interchange is 70,000 kva.

"The contract," states an official T.V.A. release, "carries forward one of the authority's objectives of effectuating lower rates to all consumers in the Tennessee Valley area. . . . "Since the arrangement as to power is on an interchange basis, the rates at which the power companies retail power is not fixed by the authority, under a specific exemption in the statute. Likewise, the five-year minimum contract period in the law is not operative to effect this arrangement."

Power Board Opposes E.E.I. Code Adoption

"Vigorous and earnest protest" against the adoption of the Edison Electric Institute-sponsored electric light and power code scheduled for hearing before NRA officials on Friday of this week was definitely promised beforehand by Frank R. McNinch, chairman of the Federal Power Commission.

"The code provision for the selection of the members of the authority being based upon the kilowatt-hour production of electric energy," stated McNinch, "clearly puts the complete domination and control of the code authority in the hands of the large power groups and will deny to Federal, State and municipal plants, including those serving the rural communities, any real or potential representation on the regulatory body."

MORE POWER TO THE NORTHWEST

If low-dam plans go through Grand Coulee will be a 700,000-hp. project. If high-dam proponents win the capacity will be 2,100,000 hp. This much-debated power and irrigation scheme for the Columbia River ranks with Tennessee Valley and Bonneville, also on the Columbia, among the government's major money-spending power schemes. The photographer has caught the shadow of two clouds on either bank of the river at virtually the precise point where the dam will rise, middle of the picture.

Insull Aids Indicted; Receiver on the Defensive

Warrants charging Samuel Insull, Jr., and six others with conspiracy to commit a felony and embezzlement and larceny from the $100,000,000 Northern Indiana Public Service Company were issued recently. Judge William J. Murray of Lake County Criminal Court had custody of the indictments, and under Indiana law they will not be made public until all the defendants have been apprehended. Those named in addition to Insull, Jr., who was formerly chairman of the board of the company, are: John H. Gulick and Edward W. Lloyd, formerly directors of the company; Morse DellPlain of Hammond, Ind., president and director; Charles W. Chase of Chicago, formerly director and vice-president of the utility and now general manager of the Indianapolis Street Railway Company; Bernard P. Shearon, vice-president and director, and Thomas G. Hamilton, former director and now general manager, of the Gary (Ind.) Street Railway Company. Messrs, Insull, Lloyd, Chase, DellPlain, Shearon and Hamilton surrendered and were released on bonds of $10,000.

Receivership collusion found

Characterizing Insull investment trusts operated in 1929 as glorified gambling institutions, Federal Judge Evan A. Evans has recently decided that the $238,000,000 Insull Utility Investments, Inc., was placed in receivership by collusion. The court absolved Calvin Fentress, former receiver and trustee in bankruptcy of the corporation, of any part in the collusion and said there was no such intrigue in the appointment of the receiver's attorneys. But Judge Evans refused to award to either Mr. Fentress or two law firms any further fees for their work, deciding they had been amply remunerated already.

As an outgrowth of developments in the Insull Utility Investments, Inc., proceedings Charles A. McCulloch, receiver for the Middle West Utilities Company, has filed a petition with Judge Walter C. Lindley in federal district court in Chicago asking investigation of the receivership. The petition asked that a rule be entered on all parties in interest requiring them to answer and set forth such grounds of objection, if any, as they may have to the continuance of the services of the petitioner as receiver and that the court summon such witnesses and make such investigation as the court shall deem wise in order to assure himself—if the court feels need of such assurance—that petitioner's appointment should be now confirmed. The court set a limit of fifteen days for answers to be filed. Progress made by the company during the period of receivership beginning April 16, 1932, was outlined by Mr. McCulloch in a tabulation of figures obtained from the most recent available financial statements of Middle West and its subsidiary companies.

In discussing the petition Mr. McCulloch said: "My principal interest is to remove the cloud over the company's name and to allay the unrest and feeling of uncertainty among executives and employees of the companies constituting the Middle West system. . . . There are more than 9,000 workers involved in this uncertainty and a monthly payroll of $1,000,000. I would like to have the situation cleared up. Also I would like to clear the good name of Ed Hurley and my own."

Puget Sound Carries Budget Case to Court

Validity of a 1933 law giving the State Department of Public Works authority to review the budgets of privately owned public utilities has been challenged in proceedings instituted in the Thurston County Superior Court by the Puget Sound Power & Light Company. This court action is the power company's answer to a recent complaint in which the department, proceeding under the new law, objected to the amounts paid in salaries to eleven executives and twenty-nine employees of the company, in addition to six other expense items listed in the company's 1934 budget.

The company petitioned the court for a writ of prohibition permanently restraining the department from holding a hearing on the budget complaint and from proceeding further against the company under the new law. Judge D. F. Wright issued an order temporarily restraining the department and setting January 25 for a hearing on the company's petition.

In its complaint the company attacked the constitutionality of the budgetary law on the ground it undertakes to confer on a purely regulatory body the power to manage the business of a privately owned utility in violation of the state and federal constitutions. The company also contended the department exceeded its jurisdiction in determining that the payment of certain expense items were objectionable because they were not proper or necessary charges against the rate-payers.

Washington Water Power Company has recently received directive orders under the same legislative enactment (ELECTRICAL WORLD, December 23, page 808).

South African Railways

Savings of $350,000 a year or more are estimated for the South African railways system when its electrification program shall have been completed. Parliamentary action will be sought in 1934 for an additional authorization of $1,500,000 to electrify about 97 track-miles. The track mileage already electrified in Natal totals 345.

Grand Jury Assails Utility Merchandising

The practice of public utilities in Indiana in general, and the Northern Indiana Public Service Company in particular, of retailing appliances in connection with the sale of gas and electricity has been condemned by the Crown Point, Ind., grand jury which recently indicted seven prominent utility operators connected with the Northern Indiana company.

"Our investigation," says the grand jury report, "discloses that the sale of appliances was carried on at a loss and such loss charged to 'new business expense' at the same time that the Utility Finance Company, another Insull company, was making about 21 per cent on the financing of these appliance sales.

"Merchandise sales made by utilities reduce the volume of sales and profits of legitimate dealers who pay taxes for the privilege of doing business and cause added expense to the company, which finally is saddled onto the consumers, who are obliged to pay, in their rates, for large sums spent for the promotion of business.

"We recommend a thorough investigation of this subject by the state of Indiana so that ratepayers may be benefited by lower rates and dealers and workmen protected from unfair competition."

Pension Plan for Hartford

Samuel Ferguson, president Hartford Electric Light Company, last week announced the impending submission of an employee pension system to workers. Recognizing the protection of employees from fear of old age and disability as an essential element for a public utility, Mr. Ferguson stated that he felt the earnings of the company were now such that it "can stand the strain."

Reinspection by Jobless

Preliminary plans for the reinspection of all wired buildings on a statewide scale are being formulated in Minnesota under the Civil Works Administration and with C.W.A. funds. Reinspection would be done by unemployed electrical workers and electricians. Any rewiring resulting from this check-up would be done through regular trade channels and at the owner's expense, without further aid of C.W.A.

Coming Meetings

American Institute of Electrical Engineers—New York, N. Y., January 23-26. H. H. Henline, 29 West 39th St., New York.

American Wood Preservers' Association—Houston, Tex., January 23-25. H. L. Dawson, 111 W. Washington St., Chicago, Ill.

Oklahoma Utilities Association—Tulsa, Okla., March 6-7. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Society for Testing Materials—Washington, D. C., March 7. C. L. Warwick, 1315 Spruce Street, Philadelphia, Pa.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

Utility Bills Defeated in Missouri and Pennsylvania

Governor Park's municipal ownership bills were completely lost when the Missouri Senate by a vote of 20 to 12 turned down a motion to force the bills from the municipal corporations committee, which had been holding them since the start of the session. The vote was a defeat for the Governor, who in his original message to the special session of the Legislature, and several times after that, urged passage of the measures. The House did pass a single measure incorporating all the provisions of the four Senate bills. The latter would have permitted cities of less than 75,000 to build or buy electric, gas or water plants or sewage disposal systems upon a bare majority vote of the people, the cost of the plants to be retired out of the revenue obtained from them.

In an open letter to Lieutenant-Governor Frank Harris, Col. Hugh Miller, state engineer for the Public Works Administration, said: "As the representative of the Public Works Administration in Missouri, I wish to call your attention to the legislative situation in the Senate. Unless corrected the situation will seriously interfere with the public works program in the state and prevent the carrying out of the policies of the President and Congress as laid down in Title 2 of the national recovery act. I feel sure the people of the state are almost unanimously in favor of this part of the President's program as evidenced by the large number of applications for loans and grants. . . ." Following defeat of the measures Colonel Miller advocated use of the initiative to obtain a state-wide vote by the people.

Legislation recommended in Indiana

The grand jury at Crown Point, Ind., which recently indicted seven directors and officials of the Northern Indiana Public Service Company has sent a report to Gov. Paul V. McNutt and the Indiana Public Service Commission listing recommendations for action on the part of these two agencies. Included in the list are: Enactment of a law to bring about more strict supervision of utility securities issues and provide for the proper disposition of the proceeds of such sales; immediate appraisement of the utility for rate-making purposes on the theory that a proper appraisal would result in lowering costs of gas and electric service by 50 per cent; refunding of contributions made to a public utility in consideration of extensions of its services instead of capitalization of these contributions for rate-making purposes; a law to provide that dividends paid must be reported to the Public Service Commission and payment of more than 8 per cent in any one year automatically would start a rate investigation; establishment of a depreciation order for each utility by the commission and maintenance of a separate depreciation fund by each utility with no discretion for waiving thereof on the part of the commission; disallowance of all money spent by utility managers for the benefit of stockholders from operating expenses and the charging thereof to income; definition of an affiliate as a company in which a utility owns 10 per cent or more, or one in which two or more of the corporate directors are common, or which is managed or operated by the same individual, group, corporation or corporations; regulations for contracts of engineering, management, construction, sales and loans between utilities affiliated; statutory prohibition of the use of any property or money of one utility for or in the behalf of another, or of any individual; criminal penalty for violation of any of the provisions of the utility act and statutory liability against those who violate it; statutory requirement that all meetings of Indiana utility directors be held in the state of Indiana; statutory prohibition against the holding of common stock in an Indiana public utility by a holding company, and criminal penalty for false entries or records in the affairs of a public utility.

Utility bills killed in Pennsylvania

The Pennsylvania Legislature ended its special session without enacting important labor, banking and public utility reform legislation for which it was convened. The bill to prevent public utilities raising rates without prior approval by the Public Service Commission was killed. The Legislature also refused to act on Governor Pinchot's five nominees to the Public Service Commission. According to Capitol Hill reports the Governor will strike back at the utility interests by including in his call for a special session next March a demand for legislation permitting municipal ownership of utilities.

At its special session, recently closed, the Kansas Legislature enacted a law providing for the erection, purchase, extension and repair of municipal utilities with funds to be borrowed from the federal government under the provisions of the national recovery act. Under this new law existing utilities may be extended or improved by a two-thirds vote of the municipal governing body without a vote of the people, although a petition signed by 10 per cent of the legal voters may force a vote. Acquisition of new utilities, however, must be submitted to the people.

Michigan Governor Renews Long Commission Fight

Characterizing members of the Michigan Legislature as "slackers" and "little less than traitors," Governor Comstock has appealed to the people of the state to help him in his fight to abolish the Public Utilities Commission as part of a program to "take the power trust off the neck of the people." He launched his direct appeal to the voters December 22 in a statement and at night in a radio hookup, declaring he will push his program at a special session of the Legislature in January.

The Governor charged that in the session of the Legislature just closed the real estate men and the public utilities joined forces to defeat the Detroit housing bill and the revenue bond bill which would provide a way for communities to bond themselves to build power plants. This he called pooling forces. "For the first time since I have been Governor," he said, "I am appealing to the people of the state. Stand behind me now if it is humanly possible."

Pinchot Renames Commissioners

Recently Governor Pinchot reappointed five public service commissioners who failed of confirmation in the special session of the Legislature just ended. Secretary of the Commonwealth Richard J. Beamish administered the oath of office, ending another cycle in the Governor's battle with the Republican organization over the commission personnel. The commissioners reappointed are: C. Jay Goodnough, chairman; P. Stephen Stahlnecker, Herman J. Goldberg, George W. Woodruff and Frederick P. Gruenberg.

Houston Street Lights Restored

Plans for restoring to service all of the street lights of Houston, Tex., 1,500 of which were shut off about a year ago, are under consideration there. Utility and city officials are conferring on proposals to reduce rates and wattages. Thus 1934 would see $167,782 expended for such service, while 1933 accounted for $135,500. Bills exceeded $200,000 in former years.

First 10-Kv. System Quits

One of the earliest feats in the history of high-tension transmission, the original 10,000-volt alternating-current system in London, England, was taken out of service at the end of December. This London installation is said to have been the first instance of transmission at this pressure underground. Forty-five years ago, when 1,000 and 2,000 volts was the limit of alternating-current transmissions to a radius of a mile or so, and when numerous direct-current stations were being set up for distribution to a radius of a few hundred yards, the late Dr. S. Z. de Ferranti conceived the idea of placing generating stations on riverside sites miles from the center of the area to be served and of transmitting energy from such stations to the point of use by means of cables operating at the then unheard-of pressure of 10,000 volts between the conductors.

The London Electric Supply Corporation, Ltd., placed the plan in effect.

General Electric Tower Now Lightning-proof

As the result of the installation of a modern lightning rod system for the new 1,000-ft., 48-story General Electric building in New York lighting research engineers of that organization see a new opportunity to observe the characteristics of natural lightning.

That all steel skyscrapers erected today are not automatically made lightning-proof by their steel frame is indicated by the performance of this particular structure before General Electric became its owner and before lightning rods were installed. During lightning storms this building had been struck and damaged on three occasions. The steel work had not been carried to the upper extremity of the tower, but was capped by more than 50 ft. of brick and terra cotta with non-grounded reinforcing members.

French Highway Lighting

Between Cannes and the Italian frontier, on the Riviera, a distance of 40 miles, French authorities have installed about 1,850 powerful lights which offer unprecedented intensities. It is said that a newspaper may be read with ease at any point along the entire distance. Headlights, being unnecessary, are absolutely prohibited.

An Electronic Telescope?

Equivalent to a 2,000-inch reflecting telescope—the largest mirror type instrument is 100-inch, with a 200-inch device in the making—a new type of astronomical instrument has been proposed by Dr. François Henroteau of the Dominion Observatory in Ottawa, Canada. Dr. Henroteau in describing the proposed electro-telescope announced research in television which made such a scheme possible.

Vulcanized Pavements

Electrically, of course, an interesting experiment in roadway construction is being undertaken in England. On a foundation of concrete is laid 2 in. of coarse tar macadam, on top of this $\frac{3}{4}$ in. of plastic rubber, troweled on by plasterers and allowed to dry. By means of a 16-kw. heater which heats an area 9 x 2 ft., affording vulcanization before rolling, the desired surface is attained.

Vapor Lamps at Port Jervis

That half-mile of sodium-vapor street lighting along Park Avenue in Port Jervis, New York (ELECTRICAL WORLD, November 25, page 675) sets a new example in the use of gaseous discharge sources. It is the first installation to use ornamental type equipment with alternating-current supply. Individual transformers are set in the base of the supporting columns. Operation is from a 6.6-amp. series primary circuit. Twenty-five Westinghouse units are inclosed in diffusing glass globes.

High-Voltage D.C. from Commutating Machine

Developed by Baltzar von Platen, Swedish engineer who produced the sensational Electrolux gas refrigerator, a new system of single-step generation of high-voltage direct current was demonstrated in mid-December before members of the Royal Institute of Technology in Stockholm.

Technical details are not yet fully available, but essentially the invention involves a motor-generator set the direct-current side of which is inclosed in an airtight container filled with an inert gas under 225 lb. per square inch pressure. More than 55,000 volts is obtainable in a single step. The commutator of this equipment is protected from flashovers by a "compensating current" which through relay action compensates, presumably opposes, the breakdown effect.

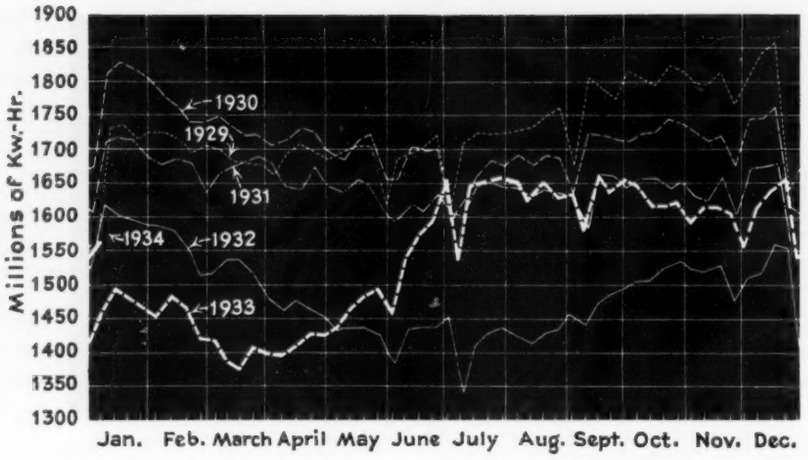
Utilization discussed is for high-voltage d.c. transmission of Swedish-generated hydro-electric energy to points in Germany. A $100,000,000 plan has been tentatively suggested for such a scheme. It is estimated that with this device one-third of such capital outlay could be avoided. In general, a decrease in cost of 30 to 40 per cent is expected.

Count Folke Bernadotte, son of the king, is chairman of the board of the Glesum Company formed to exploit the device.

SODIUM-VAPOR LIGHTS IN BELGIUM

Lodged in watertight cast-iron boxes containing a reflector and lamp accessories 532 sodium-vapor lamps of 100-watt rating are used to illuminate the interior of the recently-opened vehicular and pedestrian tunnel under the Scheldt River in Belgium ("Electrical World," September 16, page 357). Similar units, totaling 78, light the approaches as shown. This installation of monochromatic sources is but one of a number recently made where excellent results have been obtained in highway lighting.

New Year Makes Good Start



Both weeks of the recent holiday period brought greater gains in central-station energy output, compared with the same weeks a year ago, than have been recorded at any time since the beginning of October. Production during the week ended January 6, amounting to 1,563,678,000 kw.-hr., according to the Edison Electric Institute, exceeded that of the first week in 1933 by 9.7 per cent, and overshot New Year's week of 1932 by 2.6 per cent.

Progress continued in the Mountain and Central regions; in the Middle Atlantic the percentage rose to 11.3 and New England held its gain of 8.7 per cent. The South changed from a loss to a gain; on the Coast December gains were exceeded excepting Christmas week, which had an exceptional rise.

Weekly Output, Millions of Kw.-Hr.

1934		1933		1932	
Jan. 6	1,564	Jan. 7	1,426*	Jan. 9	1,619
1933		1932		Jan. 2	1,527
Dec. 30	1,539	Dec. 31	1,415	1931	
Dec. 23	1,657	Dec. 24	1,554	Dec. 26	1,565
Dec. 16	1,644	Dec. 17	1,563	Dec. 19	1,676
Dec. 9	1,619	Dec. 10	1,519	Dec. 12	1,672

Per Cent Change from Previous Year

Region	Week ended Jan. 6	Dec. 30	Dec. 23
New England	+ 8.7	+ 8.7	+ 6.7
Middle Atlantic	+11.3	+ 6.2	+ 6.1
Central Industrial	+13.0	+14.3	+ 9.6
West Central	+ 9.3	+ 4.3	+ 3.1
Southern States	+ 1.3	— 3.7	+ 1.5
Rocky Mountain	+19.1	+19.5	+16.0
Pacific Coast	+ 3.4	+ 8.6	+ 2.7
United States	+ 9.7	+ 8.8	+ 6.6

*Slightly revised from data previously published.

French Output Also Rises

Figures just made available by the French Ministry of Public Works indicate that the early months of 1933 showed notable gains over 1932 in the output of electrical energy. Reporting producers and distributors number 63 and comprise 93 per cent of the total French production. Gains over 1932 for January, February and March were 8.12, 8.42 and 10.39 per cent.

Revenue and Income Reported by Census

Revenue of $1,975,303,955 was received by electric light and power establishments during 1932 from the sale of utility service; $1,854,109,509 by commercial companies, $121,194,446 by municipal plants. Analyzed another way, $1,821,105,524 was in sales to ultimate consumers and $154,198,431 in sales for resale. Further details were given in the ELECTRICAL WORLD of January 6, page 15.

Taxes absorbed $205,150,695, or 11.9 per cent of the revenue from ultimate consumers, of which 99.4 per cent was paid by commercial companies, the municipal plants paying out only a small fraction of their receipts for taxes. Additional details as to revenue and expenditures, announced by the Bureau of the Census for operations in 1932, are shown in the table.

Composite establishments, that is, those rendering public utility service other than the sale of electrical energy, represent a large proportion of the industry, and, as a rule, their operations are much larger than strictly electrical companies.

In view of the fact that their accounting systems do not segregate electric light and power and their other service on several of the items called for on the schedule, certain items appear only in the total column. Therefore, it should be noted that these items relate to the company as a whole, and cover not only their electric light and power operations, but any other business in which they may be engaged. No data are available by states, since reporting companies were allowed to report their income, operating revenue and expense figures as a whole, without segregating their activities in various states.

Consolidated Income, Operating Revenue, and Expense Statement: 1932

(Figures are preliminary and subject to revision)

Account	Commercial Establishments: Electric light and power	Commercial Establishments: All other	Commercial Establishments: Total	Municipal Establishments: Electric light and power	Municipal Establishments: All other	Municipal Establishments: Total
Revenue from sale of utility service	[1]$1,854,109,509	$386,155,124	$2,240,264,633	[6]121,194,446	$10,042,391	$131,236,837
Miscellaneous revenue	19,254,945	6,537,065	25,792,010	1,345,043	380,734	1,725,777
Total operating revenue	1,873,364,454	392,692,189	2,266,056,643	122,539,489	10,423,125	132,962,614
Operating expenses	[2]736,692,735	223,078,513	959,771,248	[7]66,407,523	6,056,107	72,463,630
Uncollectible bills	13,903,975	2,493,925	16,397,900	951,997	87,756	1,039,753
Taxes (including Federal income taxes)	203,858,468	39,587,518	243,445,986	1,292,227	137,849	1,430,076
Retirement expenses	142,647,407	30,959,755	173,607,162	11,399,795	1,074,956	12,474,751
Total revenue deductions	1,097,102,585	296,119,711	1,393,222,296	80,051,542	7,356,668	87,408,210
Operating income[3]	776,261,869	96,572,478	872,834,347	42,487,947	3,066,457	45,554,404
Rent charge or credit to income (net)	10,827,964	4,413,533	15,241,497	33,932	[8]7,388	26,544
Balance of income[4]	765,433,905	92,158,945	857,592,850	42,454,015	3,073,845	45,527,860
Nonoperating income	(5)	(5)	61,060,120	(5)	(5)	692,491
Interest and amortization of debt discount and expense	(5)	(5)	354,165,157	(5)	(5)	7,192,855
Other deductions from income	(5)	(5)	25,871,756	(5)	(5)	1,972,149
Net income, all sources	(5)	(5)	538,616,057	(5)	(5)	37,055,347
Retirement appropriated from surplus	22,483,464	3,637,839	26,121,303	1,485,329	194,730	1,680,059
Dividend on stock	(5)	(5)	493,723,949	.....	.....	.....

[1]This total includes $1,703,303,728 revenue received from "Sales to ultimate consumer," and $150,805,781 revenue received from "Sales for resale."

[2]Includes salaries and wages, $303,058,039; purchased power, $161,120,995; cost of fuel, $102,560,395, and maintenance expense, $78,443,321.

[3]"Total Operating Revenue" less "Total Revenue Deductions."

[4]"Operating income" less "Rent charge or credit to income, (net)."

[5]Segregation of "Electric light and power" and "All other" not called for on schedule.

[6]This total includes $117,801,796 revenue received from "Sales to ultimate consumer," and $3,392,650 revenue received from "Sales for resale."

[7]Includes salaries and wages, $20,822,347; purchased power, $17,107,929; cost of fuel, $9,823,030, and maintenance expense, $9,278,580.

[8]Rent credit to income.

As to Rates——

• Public Service Company of Northern Illinois opened defense of its rate structure in hearings resumed recently before the Illinois Commerce Commission with H. H. Fields, a consulting and research engineer employed by the company, testifying that since the formation of the company in 1911 rates to residential customers were reduced from 12 cents a kilowatt-hour to 9.4 cents by 1916 and through successive cuts in 1923, 1924, 1926 and 1930 to 6.43 cents. Rates in effect in 29 communities now served by the company were anywhere from twice to more than 2½ times as high under the companies formerly serving them, Mr. Fields said. Defense of the rate structure which gives lower rates to customers in semi-metropolitan areas featured the testimony of C. G. Bennett, assistant to the vice-president of the company. The load factor in residential communities, he said, averaged about 54 per cent of capacity, while in the larger communities addition of a power demand boosted the load factor to 70 per cent.

• Electric Light & Power Company of Abington and Rockland has been supported by the Massachusetts Public Utilities Commission, which dismissed petition of residents of the town of Cohasset seeking a reduction in rates.

• Indianapolis Power & Light Company officers have been ordered by the Indiana Public Service Commission to show cause why electric rates should not be reduced. Hearing on the citation was set for February 1. Principal allegation of the petition filed by Sherman Minton, public counselor, was that the company's property valuation, upon which rates are based, is excessive.

• Madison Light & Power Company rate reductions amounting to approximately 10 per cent annually for patrons at Madison have been approved by the Indiana Public Service Commission. The reductions benefit all classes of users.

• Northern Indiana Public Service Company has been asked to reduce its rates 50 per cent in seven Indiana communities in a petition forwarded to the state Public Service Commission. The commission has recently approved rate reductions of about 8 per cent in Long Beach, Ogden Dunes and Crisman.

• Northern Indiana Power Company's rate reduction of approximately 8 per cent in New Market has been approved by the state Public Service Commission.

• Southern Indiana Gas & Electric Company's rate reduction of approximately 8 per cent in Tennyson has been approved by the state Public Service Commission.

• North Adams Gas Light Company has been ordered by the Massachusetts Public Utilities Commission to revise its rates for domestic electricity to effect a new residence rate providing for a charge of 7½ cents gross for the next 22 kw.-hr. after the first three delivered each month; that the gross charge of each step thereafter be increased by ½ cent; that the penalty clause be eliminated and that a clause be included providing for a ½ cent discount per kilowatt-hour if paid within ten days.

• Indiana Public Service Commission has notified Indiana public utility companies that the collection of penalty charges from consumers whose monthly bills have run delinquent must be discontinued by February 1. Members of the commission say that in some cases the penalty charges were as high as 21 per cent of the actual service charge.

• Georgia Power & Light Company and the state Public Service Commission have reached an agreement on eliminating the service charge from the schedules of the company and cutting the bills of the consumers in the lower brackets. The revision is estimated to save the consumers approximately $14,000 a year on the basis of last year's consumption. Consumers using less than 50 kw.-hr. per month derive the major benefits.

Municipal Items

WEAVERVILLE, CAL.—Despite the announcement of a 12½ per cent reduction in rates by the Weaverville (Calif.) Electric Company just a few days before the election, voters of that city have approved a measure for the formation of a public utility district to acquire and operate a publicly owned electric system by a majority of 3½ to one. Application for a valuation of the existing utility's system, followed by condemnation and the voting of revenue bonds for the purchase, is necessary before the system will be publicly owned.

AUGUSTA, GA.—Proposed $2,500,000 municipal power plant on the Augusta Canal has been denounced before the National Public Works Administration in Washington by Charles A. Collier, vice-president of the Georgia Power Company, as impractical both from an engineering and a financial standpoint. He declared that his company, which is now serving Augusta with power, was providing cheaper power and more efficient service than could be rendered by the proposed municipally constructed plant.

ST. PAUL, MINN.—Mayor Mahoney has launched a campaign for a municipal electric plant with the introduction of an ordinance providing for a ten-million dollar bond issue for a 30 to 40 per cent installation. This would place the total cost of the plant at between $25,000,000 and $33,000,000.

AKRON, OHIO.—City Council utilities and finance committee has announced that it had made its final overture to the Ohio Edison Company in a letter to A. C. Blinn, vice-president, offering the utility company one more chance to accept the Sanderson-Bixler light rate, enacted by the old Council, which would mean a saving of 90 cents a month to the 50-kw.-hr. consumers. Regardless of the company's answer on the rate proposal, Council will continue its efforts for the establishment of a city-owned plant.

CAMDEN, N. J.—Public Service Electric & Gas Company of New Jersey called 28 witnesses last week at a hearing in its suit to prevent this city from building a municipal electric plant. Testimony heard by William B. MacDonald, special examiner for the New Jersey Public Utilities Commission, developed that signatures appearing on petitions by which the election was called were all but one authorized. Mayor Roy R. Stewart admitted that the city had exceeded its borrowing power, and in order to build the plant would need $7,000,000 of federal money and an outright grant of $3,000,000.

SULLIVAN, MO.—Testimony in the injunction suit of the Sullivan Electric Power Company, which seeks to restrain the city perpetually from building an $80,000 municipal electric plant, was begun last week in the court of Circuit Judge McElhinney at Clayton. Voters of the city have authorized an $80,000 bond issue for the purpose, and the city formally has petitioned the Public Works Administration for a loan of $85,000 to finance the project. The company, however, has a twenty-year contract with Sullivan which does not expire until 1945. The company brought suit to enjoin the city, while the city countered with a $40,000 damage suit against the company, charging impaired credit of $10,000, court cost of like amount, and adding $20,000 for punitive damages. In bringing the suit the company alleged the Mayor and Council coerced and intimidated voters into favoring the bond issue. It contends it has spent $125,000 to serve Sullivan and charges the $80,000 proposal of the city is inadequate.

CHESTER, ILL.—By a vote of 950 against and 781 for voters on January 3 rejected a proposal that the city should issue $158,000 in utility certificates to be retired from the earnings of a proposed municipal light and power plant. The city had previously applied for a grant and loan from the Public Works Administration.

FINANCIAL AND BUSINESS NEWS

N.E.M.A. Code Rehearing Stormy

VIGOROUS differences of opinion between electrical manufacturing code representatives and NRA officials developed at the rehearing before General Johnson this week. The National Electrical Manufacturers' Association sought to secure a supplementary code, or amendments, which would permit price fixing and the filing of price lists. The NRA labor advisory board recommended the establishment of a 35-hour, five-day week in lieu of the present 36-hour week; limitation of overtime to seven hours a week for six weeks in each six-months period, with pay at time and a half for all over seven hours a day and 35 hours a week, a minimum wage for common labor of 45 cents an hour and for office workers of $16 a week and elimination of the provision that learners be employed at 80 per cent of the minimum.

Price-fixing proposals by N.E.M.A. read in part as follows:

"The supervisory agency shall have the power on its own initiative or on the complaint of any employer to investigate any prices for any product" . . . and "if the supervisory agency after such investigation shall determine that such price is an unfair price" . . . "the supervisory agency may require the employer who filed the list or discount sheet in which such unfair price is shown to file a new list or discount sheet showing a fair price for such product" . . . and if the employer fails to comply within ten days "the supervisory agency shall have power to fix a fair price for such product."

Lamp manufacturers, as anticipated last week (ELECTRICAL WORLD, page 58), were loud in their protests that competitive price conditions must be maintained "unless there is to be a complete socialization of industry with the government setting prices."

Wholesalers seek revision

Amendments to the NRA code of the electrical wholesale trade were likewise submitted for hearings this week. Involved are qualifications of the conditions under which sales may be permitted below costs or at prices different from manufacturers' lists.

Staten Island Edison Loses

Orders of the New York Public Service Commission directed against the Staten Island Edison Corporation's issue of $7,500,000 bonds have been affirmed by the Court of Appeals in Albany. Several months ago the Appellate Division affirmed the orders (ELECTRICAL WORLD, July 15, page 68), but the ruling was not unanimous and the corporation appealed its case.

Malcolm Muir Leaves NRA

After serving as division administrator of the National Recovery Administration and as one of the chief aids to General Johnson since the inception of NRA (ELECTRICAL WORLD, July 8, 1933, page 39) Malcolm Muir, president of the McGraw-Hill Publishing Company, Inc., has resumed his full-time activities with the publishers of ELECTRICAL WORLD and resigned from NRA.

Sinking Funds Favored by President Roosevelt

Greatly to the immediate favor of railroad and utility shares, at least as reflected in a sharp speculative reaction marketwise, President Roosevelt let it be known at a press conference on Wednesday of this week that he favored establishment of sinking funds for the retirement of the bonds of such enterprises. Systematic retirements which would be taken into consideration by regulatory bodies in establishing rates were specifically commended.

As part of this viewpoint Mr. Roosevelt indicated that many utilities, particularly railroads, had an overlarge share of their capital structure in the form of bonds, placing an excess burden on the capital structure in times of reduced earnings.

OFF TO A GOOD START

First of the telltales of 1934 to become available to eager seekers of business facts, the figures for electrical energy output, week ended January 6, are definitely encouraging—up 9.7 per cent from last year and at least 1 per cent over 1931, the bellwether since the past midyear. Late 1933 reports on other important indexes of activity are encouraging too; total carloadings for the year 2.8 per cent above 1932; retail sales increases continue and lead to wide replacement buying on the part of dealers; steel production holds earlier gains; automobile activity in show-season spurt gains more sharply than in any week in the past two months; bituminous coal output regains previous loss.

As to prices, little change occurred. Stocks, bonds and commodities just avoided marked weakness in small downward shifts and rallies.

Conclude, if you will, that an old-fashioned, or at least quite conventional, revival of trade could easily get under way. Credit the hesitancy of the moment to unabated monetary apprehension. Await the final perfidy which will permit government confiscation of 50 per cent or less of the dollar. And—one will not be far from right. 1934 is off to a favorable, if unmoral, start.

Portland Electric Power Writes Down Stock Values

By a write-down in the value of the common and second preferred stocks of the Portland (Ore.) Electric Power Company, owner of Portland General Electric Company and Portland Traction Company, $8,000,000 has been added to capital surplus. The action was voted by the stockholders and given effect by amendments filed with the Oregon state corporation department.

The common stock, former par value $20, was given a $1 par, while the second preferred stock was written down from $100 to $1. Practically all of both these issues is owned by the parent company, Central Public Service Corporation. One hundred and thirty-eight thousand shares of common, 65,000 shares of second preferred were affected.

Capital surplus thus created is being used to adjust downward the value of various securities of affiliated companies held in Portland Electric Power Company's portfolio to bring the book value of these investments to their actual value.

Cutler-Hammer Reports

Cutler-Hammer, Inc., reporting net shipments for the year ended December 31, 1933, showed a value of $3,654,000, as compared with $3,002,000 in 1932. For the final quarter of 1933 net shipments were $1,046,450, against $1,170,512 in the preceding quarter and $700,635 in the fourth quarter of 1932.

Franchise Cancellation Asked in Oklahoma

At the request of Governor Murray the Attorney-General of Oklahoma is investigating the appeal of a Tulsa citizen that the franchise of the Public Service Company of Oklahoma be canceled. The ground for complaint has not been revealed.

Laclede Gas Cited on Securities Law

To determine whether or not a false statement of fact was made in registration under the federal securities act, the Federal Trade Commission has initiated proceedings, the first of this nature, to halt a security exchange plan. Involved is the Laclede Gas Light Company of St. Louis, operating gas utility of Harley L. Clarke's Utilities Power & Light system.

The gas company must show cause why a stop order against the company's recent $3,000,000 issue of first mortgage collateral and refunding bonds of 1963 should not be issued. The securities were given in exchange for a similar issue maturing in 1935.

It is alleged that in answering "none" to question No. 17 on the commission's questionnaire requiring statement "of all litigation pending, if any, that may materially affect the value of the security offered," the company was at fault since two important rate proceedings were pending when the questionnaire was answered. Hearings were to begin on Friday of this week.

Foreign Power Meets Maturity

C. E. Calder, president of American & Foreign Power Company Inc., announced on Monday that provision had been made for the $10,000,000 five-year note of South American Power Company (a subsidiary of American & Foreign Power Company, Inc.) then due. Twenty per cent of the note was paid in cash and in addition certain foreign securities held simply as a minority investment were transferred as a further payment. The balance of the obligation has been made payable in pounds sterling, amounts to £1,508,870 and is due in one, two and three years. The renewal interest rate is 6 per cent, the same as the old note. American & Foreign Power Company, Inc., and subsidiaries' cash on deposit in New York after provisions for the cash payment as above was approximately $7,200,000.

Utilities to Meet Survey Charges

Contest over the right of the Illinois Commerce Commission to assess the costs of investigations and surveys made in determination of values for rate-making purposes against utility companies investigated failed to materialize at a hearing held last week. Counsel for the larger companies announced that the bills submitted by the commission would be paid, but under protest and with the reservation to make an attack on the legality of the law later. The amounts involved are small, the largest being an assessment of $18,154 against the Public Service Company of Northern Illinois.

Dividend Changes

Utility and manufacturing company dividend changes recently announced include:

Engineers Public Service Company. Dividends on the organization's cumulative preferred stock have been deferred because of greatly reduced earnings. NRA costs and new energy tax are factors.

Westinghouse Electric & Manufacturing Company. Payment of 87½ cents a share on preferred stock voted.

British Shares at Highs

One of the features of British stock markets as 1933 ended was the keen investment demand for the shares of electricity supply enterprises. Most of the leading issues finished the year at or around record high levels. Despite the low yields obtainable investors were attracted to the industry on account of its proved capacity for expansion of output and profits. In America the other extreme was reached with shares at new lows. Output figures published to date disclose a large increase over those of 1932. The indication is that 1933 will be 10 per cent above last year, which was itself a record in the history of the industry.

Illinois Public Service Plans Stock Write-Down

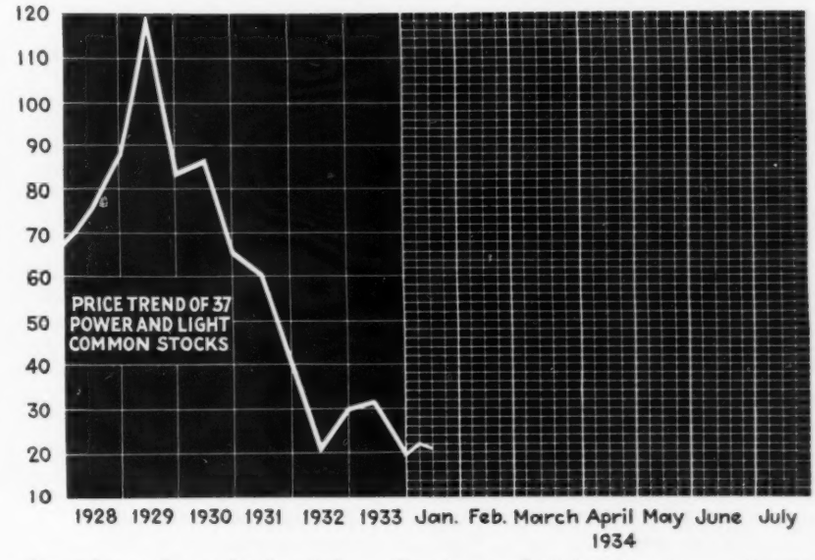
Another step in the rehabilitation program of the new management of the Public Service Company of Northern Illinois was taken this week when directors voted to propose a recapitalization plan to stockholders. Pending adoption of the plan, action on preferred and common dividends has been deferred.

The plan to be voted on by stockholders at the annual meeting February 26, assuming the necessary approval of the Illinois Commerce Commission to be forthcoming, would provide for the writing down of the $100 par value common stock to $60 a share and the stated value of the no-par value common stock to an equivalent figure. The reduction in stock value will create a capital surplus of approximately $25,000,000 to be disposed of as follows: $12,000,000 as an additional reserve to cover any shrinkage in value of the investments in Public Service Subsidiary Corporation, $6,500,000 as a new reserve for ultimate liquidation of the Public Service Subsidiary Corporation and $6,500,000 to be retained as capital surplus. This will be in addition to the surplus as of December 31, 1933, which will be transferred to capital surplus incident to the creation of these reserves.

Tokyo Decision Reversed

Tokyo Electric Light Company, successor to Shingetsu Electric Power Company, Ltd., has altered its decision regarding gold clause observances in

Utility Security Prices Unchanged



In markets only notable for their small volume and slight price changes electric light and power common stocks in the "Electrical World" average stood at the same point as last week, 21.1.

payments on its own and predecessor company securities (ELECTRICAL WORLD, December 9, 1933, page 743). Payments will be made to foreign holders in sterling at the expressed rate of exchange.

North Carolina Order Curbs Dividend Policies

Payment of dividends by utilities coming under the supervision of the North Carolina Utilities Commission are hereafter rigidly circumscribed by a five-point order of Commissioner Stanley Winborne. The restrictions stipulated are:

1. No utility shall use any part of its surplus in the payment of dividends on its common stock except upon showing the necessity therefor.

2. No utility with indebtedness, in addition to that for current expenses, shall declare dividends in any amount in excess of its net income after depreciation and in no case shall the dividends exceed 6 per cent a year.

3. Where any utility without indebtedness declares a dividend in excess of 7 per cent it will be deemed *prima facie* evidence that rates are unreasonably high and the utility will be called upon to show cause why its rates should not be immediately reduced.

4. No utility may increase its capital stock, in any manner, for any consideration except after specific authority from the commission.

5. Rates of depreciation are limited to 4 per cent for telephone utilities; 3 per cent for electric utilities and 2 per cent for artificial gas utilities, and these percentages may not be unreasonably decreased to increase the net revenue.

$5,000,000,000 Market?

As the result of its observations of a sharp upturn trend toward home electrification the National Retail Dry Goods Association predicts a $5,000,000,000 market for electrical appliances in the United States this year.

St. Lawrence Certification

President Roosevelt is reported to have ordered full speed ahead on the ratification of the Great Lakes-St. Lawrence waterway treaty. Senate leaders have been instructed that he desires the treaty approved with minimum delay. The project calls for about $175,000,000 to be expended by the federal government for navigation works and $84,726,000 for the development of water power to be allocated to the State of New York.

General Electric Orders Up 17 per Cent in 1933

Orders received by the General Electric Company during the year 1933 amounted to $142,770,791, compared with $121,725,772 for 1932, an increase of 17 per cent, President Gerard Swope announced this week.

Orders for the quarter ended December 31 amounted to $37,985,790, compared with $27,351,658 for the last quarter of 1932, an increase of 39 per cent. Sales billed and earnings for the year of 1933 are not yet available; the complete annual report will be issued in March.

Foster Wheeler Award

Based upon the alleged infringement of a steam economizer patent owned by Foster Wheeler Corporation, an award has been made in the U. S. District Court in New Haven, Conn., against the B. F. Sturtevant Company to the amount of $207,812.

Brown Boveri in Canada

Canadian representation on behalf of Brown Boveri & Company, Ltd., will be handled hereafter by the Swiss Electric Company of Canada, Ltd., instead of Messrs. Griswold & Company, Ltd.

Canada Wires Homes

More than 13,000 Canadian homes were wired for electrical service last year, states D. C. Durland, president Canadian General Electric Company. This brings the total to 1,500,000, or approximately 75 per cent of the total homes in that country. According to Mr. Durland 14,000 electric water heaters have been placed in service since April. Of the 35 greatest industries of the Dominion one-third are 90 per cent electrified, and three-quarters are 80 per cent electrified.

Electric Boilers in Canada

It is estimated that nearly 20 per cent of the total output of electrical energy in the Dominion of Canada in November of last year was used in electric boilers for the production of industrial steam. About 375,579,000 kw.-hr. is so accounted for. This is, roughly, one-third more than was used in October. Newsprint mills absorb much of this service. The use of electric boilers in Quebec is more widespread than in the other provinces, boilers in that province having used 272,148,000 kw.-hr. during November. Ontario reported 77,389,000 kw.-hr. of energy consumed in this way, while Manitoba recorded a consumption of 25,883,000 kw.-hr. British Columbia's electric boilers used only 159,000 kw.-hr.

New Texas Hydro Planned

Construction of a large hydro-electric plant in connection with the Caballo Dam and water storage reservoir which is to be constructed on the Rio Grande in New Mexico, at a point between the Elephant Butte Dam and El Paso, is proposed by the Water Users Association of the Rio Grande Valley. Assurances have been received by the promoters of the project from mine owners and industrial concerns of a large area of New Mexico and El Paso that they would enter into contracts to use such power. A capacity of 50,000 hp. is tentatively proposed.

New York Metal Prices

	Jan. 2, 1934 Cents per Pound	Jan. 9, 1934 Cents per Pound
Copper, electrolytic	8.25	8–8.25
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.25	7.25
Nickel ingot	35.00	35.00
Zinc, spot	4.70	4.60
Tin, Straits	53.00	51.875
Aluminum, 99 per cent.	23.30	23.30

Major New Construction This Week

Heavy-duty motors, controls, regulators, conveyors, electric welding and other equipment will be installed in new steel pipe mill at Brier Hill works of Youngstown Sheet & Tube Company, Youngstown, Ohio. A $1,000,000 project.

Bids will soon be asked by Department of Interior, Washington, D. C., for equipment and materials for new 300-mile transmission line between Great Falls, Mont., and Fort Peck project on Missouri River. Wood poles and copper cable for three-wire system to be used.

Galax, Va., plans city-owned hydro-electric plant on New River, transmission line and two substations. Cost $365,000.

Owings Mills Distilling Company, Owings Mills, Md., plans $100,000 expansion.

Department of National Parks, Buildings and Reservations, Washington, D. C., will build $133,000 power plant at Wind Cave National Park, S. D.

Motors, controls, regulators, conveyors, etc., will be installed by New England Chemical Industries, Inc., Woburn, Mass., at cost of $150,000.

Lexington, Miss., plans $100,000 city power plant.

Bureau of Yards and Docks, Navy Department, Washington, D. C., has secured appropriation of $1,400,000 for new radio stations and radio communication facilities at Pearl Harbor, T. H., and Summit, Canal Zone.

Middlesboro, Ky., plans $328,000 city-owned Diesel engine-generating plant.

MEN OF THE INDUSTRY

James F. Fogarty Heads North American Company

James F. Fogarty, for the past eleven years vice-president of the North American Company, was elected president of that organization, at a meeting of the board of directors held last week, to succeed the late Frank L. Dame. Mr. Fogarty, who has been with the company 31 years, is also a director and a member of the executive committee.

A native of Philadelphia, Mr.

Fogarty entered the electric light and power industry in 1902 as a stenographer for the North American Company and by successive advances became assistant secretary in 1910, secretary in 1912, a director in 1914 and vice-president in the spring of 1923.

At intervals during his long period of service he has spent considerable time on the properties studying at first hand the operating methods of the North American subsidiaries, of which he has been an officer and director for many years. The subsidiaries include electric light and power companies serving territories centering in Cleveland, Milwaukee, St. Louis and Washington, D. C. He is outstanding as a comparatively young man among executives of large corporations, especially as a self-trained expert in financial matters, whose business career has been unusually long for one of his age, now only 46.

Mr. Fogarty became president last year of North American Edison Company, principal subsidiary of the North American Company, and had been vice-president and a director since the organization of that subsidiary in 1922. Since January 30, 1933, he has been president of North American Light & Power Company of Chicago and is also a director of that company and vice-president of the Detroit Edison Company, in both of which companies the North American Company has substantial interests.

DAVID R. HAWKINS, a member of the law firm of Sullivan & Cromwell, general counsel for the North American Company, and who has long been associated with the affairs of the company, was elected to membership on the board of directors to succeed Mr. Dame.

C. S. McCain New President United Light & Power

Charles S. McCain, chairman of the board of directors of the Chase National Bank, will assume the duties of president and chief executive officer of the United Light & Power Company, Chicago, on February 1 to succeed William Chamberlain, who will become chairman of the board. A native of Pine Bluff, Ark., Mr. McCain was graduated from Yale University in 1904 and entered the banking field in his native state. He has been in the commercial banking field in New York since 1926, when he became vice-president of the National Park Bank, in the following year assuming the presidency. When that institution merged with the Chase in 1929 he became president of the consolidated bank, and in the following year, when the Equitable Trust Company was merged, he became chairman of the board.

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WALTER C. HESTON, for many years Pacific Coast editor of the ELECTRICAL WORLD, has become affiliated with the Biddle Trade Bureau and will be engaged in its association work from the San Francisco office.

OBITUARY

F. D. SHAFFER, prominently identified with the public utility industry in Oklahoma, died suddenly at his home at Lawton, December 30, after a long period of impaired health. The funeral was held at his former home, Cincinnati, Ohio. Mr. Shaffer was for many years president of the Chickasha Gas & Electric Company and became vice-president of the Southwestern Light & Power Company when the latter company purchased the properties of the former. He retired from active administrative responsibilities about two years ago. Mr. Shaffer was a charter member of the Oklahoma Utilities Association and for several years a member of its executive committee. He was 64 years of age.

Clare N. Stannard

Clare N. Stannard, vice-president and general manager of the Public Service Company of Colorado, and one of the leading executives in the Henry L. Doherty organization, died January 3 in Denver, of pneumonia. Mr. Stannard entered the public utility business when he was 21 years of age and had been associated with electrical properties in Denver for 35 years. His first connection with the utility industry was made in New York, his native state, as an employee of the electric and gas

company in Binghamton. Street railway operation then took his attention, and after a brief period in the South he went to Denver, where he secured a position with the tramway company.

One year later Mr. Stannard joined the Denver Consolidated Electric Company, the forerunner of the Denver Gas & Electric Company, which in turn was merged with the Western Light & Power Company to form the Public Service Company of Colorado. During this period he had advanced from a position in the auditing and cashier's department to the office of vice-president and general manager. Mr. Stannard was active in association work, having served as president of the Rocky Mountain Division of the National Electric Light Association. He was 64 years of age.

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CHARLES DUNCAN, founder of the Duncan Electric Company, Ltd., Montreal, died December 19 in the Montreal Western Hospital. A native of Dundee, Scotland, Mr. Duncan went with his parents to Sherbrooke, Quebec, and entered the electrical and machinery business there, later going to Boston, Mass., in the same business. About 30 years ago he returned to Canada, establishing his company in Montreal.

NEW EQUIPMENT

Improved Electrode for Welding Cast Iron

An electrode for welding cast iron by the shielded arc process is announced by the Lincoln Electric Company, Cleveland, Ohio. The electrode, known as "Ferroweld," not only simplifies welding procedure on cast iron but is stated to produce a weld with greater strength and ductility than the cast iron. "Ferroweld" has a steel core surrounded by a heavy flux coating which protects the arc from gases injurious to the weld which are present in the atmosphere.

One of the outstanding advantages claimed for "Ferroweld" is the remarkably low heat with which it can be used, thus reducing the possibility of cracking. The electrode is manufactured in only one size—$\frac{1}{8}$ in.—and is used with approximately 80 amp. of current. Welding is done intermittently, not over a 3-in. bead being laid down at one time. As each bead is welded it is peened lightly, thoroughly cleaned and allowed to cool somewhat before the next bead is deposited. Due to the extremely low current with which it is used the hardening effect ordinarily present along the line of fusion is materially reduced. Thus the weld is more machinable than most cast iron welds.

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A METAL CIRCULAR SLIDE RULE designed to be carried in the vest pocket has been announced by the Tavella Sales Company, New York, under the trade name of "Tasco." It is grease- and water-proof. An advantage of this slide rule is that it can be dropped, trampled on or immersed in liquids without being damaged or its accuracy lessened.

SMITHJOHNS POLE TOP FIXTURE which systematizes line construction and insures permanence stronger than standard crossarm construction at less cost has been announced by the Decatur Malleable Iron Company, Decatur, Ill. Standard wood or metal pins are clamped in metal sockets. Metal parts are cast in halves, with radial jaws forming clamps to wood members. Struts are treated hardwood, increasing safety factor for live line work.

TO MEET THE INCREASING NEED for suitable equipment for properly bright annealing both ferrous and non-ferrous products, as well as for other processes demanding controlled heat treating, the Pittsburgh Lectromelt Furnace Corporation has developed and perfected the "Lectronealer," built in two types, the circular and the rectangular. The "Lectronealer" has many advantages. It is of the removable hood type, with heating elements in the hood, and many patented features are incorporated in its construction.

Strain Insulator Fittings

So as to develop the full strength of porcelain strain insulators, the Ohio Brass Company, Mansfield, Ohio, has designed a new line of strain fittings.

The two sizes in which this fitting is made will accommodate all of the various sizes and makes of standard strain insulators. The fittings consist of a yoke and a length of stranded cable, each end of which is flash-welded to a machined ball-terminal, similar to the ball-socket attachment of suspension insulators. Due to the fact that the strand closely conforms to the contour of the insulator, it is possible to develop the full strength of the porcelain insulator.

The yoke has two sockets into which the terminals fit. The opening in these sockets is placed so as to eliminate the possibility of uncoupling under impact or when the strain on the fittings is suddenly released. In addition to this, the top of the socket is recessed to receive the ball of the terminal under recoil, making the assembly doubly foolproof against uncoupling.

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A DISTRIBUTION TRANSFORMER CUTOUT known as the "Semaphore," which can be mounted on two insulators or on a single insulator, or the fittings only can be assembled to existing insulator mountings with little difficulty, has been announced by Schweitzer & Conrad, Inc., Chicago. This device has high interrupting capacity and equal dependable performance under both low fault conditions and heavy short circuits. Incorporated in this device is the same principle of short-circuit interruption as is applied to the better-known S & C liquid fuse, except that the "Semaphore" has no extinguishing liquid.

Manually Operated Indoor Oil Circuit Breaker

A manually operated indoor oil circuit breaker known as the type E-10, especially designed for the protection of large motors and for general utility in the industrial field, has been announced by Condit Electrical Manufacturing Corporation, Boston, Mass. The type E-10 is furnished full automatic or non-automatic, three pole, single throw for 300 amp. or less at 2,500 volts with an interrupting capacity rating of 10,000 kva.

A special feature of the new breaker is an improved copper contact structure which involves the essential features of high thermal absorption in the arcing contacts and liberal current-carrying capacity in the main laminated contacts. The arcing contacts are held firmly together by strong spring action, assuring adequate protection to main contacts on closing and opening, and are of butt type, which has been found superior to other forms for making and breaking large currents.

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THE SHARPLES SPECIALTY COMPANY, Philadelphia, Pa., has announced a new Sharples laboratory super-centrifuge which makes available an extremely high separating force and unusually smooth and efficient performance for the laboratory operations for which it is designed, namely, the sedimentation of solids from liquids, the clarification of liquids and the separation of immiscible liquids occurring as mixtures and emulsions.

ANNOUNCEMENT OF A "LECTRODRYER" which will effectively dry air and gases has been made by the Pittsburgh Lectrodryer Corporation, Pittsburgh, Pa. Air saturated with moisture when passed through the "Lectrodryer" comes out with a dewpoint below minus 60 deg. C. It is readily adjustable to standard or special processes for the preparation of annealing gases and is available in standard sizes so that it can be readily substituted for present chemical or refrigeration units for drying.

THE SLIP-LENS COMPANY, New York, has announced a new slide rule magnifier, known as the "Slip-Lens." It is attached to the slider by suction and enlarges the figures and division to twice their actual size. The lens can be shifted readily from one scale to the other, leaving one scale free for rough calculations.